# MINDFULNESS, ITS MEASUREMENT AND EFFECT ON A PARADIGM OF PERSISTENCE WITH BEHAVIOURAL CHANGE

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# Declaration

I confirm the thesis has not been submitted for a degree at another university.

I declare Study 3 is my sole work. Study 1 and Study 2 are co-authored with Nick Chater and Derrick Watson who both provided valuable advice on designing the paradigm of persistence with behavioural change. The paradigm was programmed by Derrick Watson in BlitzMax.

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# Abstract

This doctoral thesis presents three Studies covering the topics of mindfulness, its measurement, and its effect on a paradigm of persistence with behavioural change. The paradigm is introduced in Study 1 as a novel way of assessing persistence with behavioural change. Persistence is assumed to be necessary if one wishes to shift from a habitual to a novel behaviour as the latter option provides little rewards compared to its alternative in the initial phase of behavioural change. The results showed, similarly to real life, that people varied in their choices: some stayed with the habitual behaviour, others switched to the novel option but not all stayed with it, and subsequently returned back to the original behaviour. Study 1 presents a number of applications of the paradigm as well as suggestions for assessing construct validity. One possible way of applying the paradigm is to test how it is influenced by mindfulness. Mindfulness is focusing attention on the present moment with attitudes like acceptance and openness. Hence the more mindful people are the easier they may find to persist with behavioural change as their attention is more focused and they are more accepting when dealing with the frustrating nature of the change. This relationship is investigated in Study 2 where mindfulness is briefly induced with a short meditation and also assessed as a trait. The study revealed an unexpected pattern between trait mindfulness ratings and paradigm variables when each condition was considered separately. Further investigation supported the argument that the pattern could be due to the influence of immediate context, namely induction content and performance on the paradigm. Implications for the findings, such as the stability of trait questionnaires, are discussed. Moreover, mindfulness was found to enhance persistence with behavioural change but only in one of the experiments. It is possible the brief mindfulness induction is not strong enough. Brief mindfulness induction is the focus of Study 3, including a literature review of over 70 studies applying this method. The analysis showed a high variation in various methodological aspects, such as the content, length and type of inductions. The fit of induction content with existing definitions of mindfulness is discussed further as well as the suitable length of inductions. Recommendations for improvement of the methodology are suggested. The whole thesis provides a number of theoretical and methodological contributions, directions for future research and practical applications.

# Chapter 1

# Introduction

## Background

Principles of mindfulness have origins in Buddhist traditions. In the 1970s, mindfulness was included in a programme helping people to cope with stress at a Western clinic, marking the first official use of this concept amongst scientific communities (Jon Kabat-Zinn, 2003). Since then, mindfulness has become popular not only amongst researchers and practitioners, judging by the growing number of mindfulness-related publications and courses, but also in Western popular culture, including media articles and self-help books.

There are a number of ways mindfulness can be conceptualised. The proposed definitions list dimensions including the intention behind present centred focus (Shapiro, Carlson, Astin, & Freedman, 2006), attention and awareness of a current moment (Brown & Ryan, 2003), a particular orientation towards the present moment including acceptance and openness (Bishop et al., 2004), or insight characterised by an experiential grasp of wisdom laid out by Buddhist teachings (Bodhi, 1998).

In order to assess mindfulness experimentally, mindfulness trait and state questionnaires were developed (e.g. Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008; Lau et al., 2006), effects of mindfulness were compared prior and post mindfulness-based courses (e.g. Segal, Williams, & Teasdale, 2012), and the impact brief mindfulness inductions had on dependent variables was compared to control conditions in a laboratory environment (e.g. Hafenbrack, Kinias, & Barsade, 2014).

Research into mindfulness has considered its influence on a wide array of areas, for instance, dealing with chronic pain (Ussher et al., 2014), depression recurrence prevention (Teasdale et al., 2000), aggression alleviation (Heppner et al., 2008), reduction of decision biases like sunk-cost (Hafenbrack et al., 2014) or negativity biases (Kiken & Shook, 2011), enhanced negotiation (Reb & Narayanan, 2014), emotion regulation (Gilbert & Gruber, 2014), healthy eating (Jordan, Wang, Donatoni, & Meier, 2014), behavioural change (Brewer et al., 2011), and relapse prevention (Sarah Bowen et al., 2014).

# Objectives of the thesis

One of the objectives of the thesis is to explore how mindfulness influences persistence with behavioural change. Persistence with behavioural change is staying with a novel behaviour without returning back to a habitual behaviour during the initial, frustrating phase of behavioural change. The concept of persistence with behavioural change is similar to the concept of behaviour change maintenance, although there are also some crucial differences, namely different temporal scope and applicability. In previous studies, behavioural change maintenance was most commonly measured as a self-reported outcome (Black, Sussman, Johnson, & Milam, 2012) or indirectly via biological measures (e.g. Bowen et al., 2014). In the present work, a different type of assessment is applied. Concretely, a laboratory simulation of real-world persistence with behavioural change is developed, which enables a direct, objective, and general measurement of this process. This simulation is called the paradigm of persistence with behavioural change because the main goal is to measure whether people persist with a changed behaviour without relapsing back to a habitual behaviour, e.g. stopping smoking. Subsequently, mindfulness is induced briefly in the laboratory as well as assessed as a trait via a self-reported questionnaire, and how it effects responses on the paradigm is investigated.

Whilst the paradigm of persistence with behavioural change was being developed and its relationship with mindfulness tested, the findings from this investigation pointed at two possible issues with the methodology for measuring mindfulness. The first issue is the potential influence of immediate context on self-reporting in trait mindfulness questionnaires. The second issue concerns the use of the brief induction method, and what outcomes it leads to. Revealing both of these issues was unexpected, and resulted in mindfulness methodology becoming the main focus of the thesis. Thus the thesis includes the investigation of the two methodological issues, the effect of mindfulness on the persistence with behavioural change paradigm, and the development of the paradigm itself.

These topics form three studies. The first study focuses on the development of the experimental paradigm of persistence with behavioural change. The second study then investigates how mindfulness relates to the choices people make in the paradigm. It also assesses whether trait mindfulness questionnaires can be influenced by immediate context. The last study deals with the brief mindfulness induction methodology.

# Structure of the thesis

The present thesis consists of six chapters. The aim of the current chapter, Chapter 1, is to introduce the thesis and provide a brief preview of the coming chapters in order to enhance navigation within the work. Chapters 2 to 6 are briefly described in short below.

## *Chapter 2: Background Literature Review*

The first aim of Chapter 2 is to provide a background literature review for the three studies and thereby space for more detailed description of the main themes appearing in the studies. The second aim of this chapter is to explain how these themes complement the existing research. The chapter has three parts. The first part focuses on mindfulness definitions, given mindfulness is the key concept of the present thesis. The way mindfulness is understood also has an impact on critical discussions regarding mindfulness assessment in Study 2 and Study 3. The mindfulness concept is firstly described from a Buddhist and then from a Western perspective. Both perspectives are subsequently compared and conclusions are drawn. The second part of Chapter 2 is centred on mindfulness methodology. Trait mindfulness questionnaires are described and mindfulness inductions are explained, including mindfulness programmes and brief mindfulness inductions. Issues with each method are then highlighted. The last part of Chapter 2 is based on the discussion of the relationship between mindfulness and behavioural change. Previous findings of the effect of mindfulness on behavioural change are presented and the methodologies applied in these studies are briefly evaluated.

## *Chapter 3: Paradigm of Persistence with Behavioural Change (Study 1)*

The following chapter includes the first study of this thesis. Study 1 focuses on the development of an experimental paradigm to study and measure persistence with behavioural change. Persistence with behavioural change is a tendency to stay with a new behaviour without relapsing back to an old, habitual behaviour. Hence the paradigm presents a choice between two behavioural options: habitual and novel. The habitual option is easy to perform and brings predictable, small outcomes. The novel option is difficult to execute at first and demands a degree of persistence through the initial lack of rewards. However once it is mastered, it results in outcomes that are larger compared to the habitual alternative. Overall, choosing the novel behaviour and persisting with it leads to the greatest outcomes for the majority of people. Consequently persistence with the novel option is the optimal strategy of the paradigm. One crucial point is that participants are informed about the optimal strategy applicable to the majority before they start working on the paradigm – they do not need to learn this by themselves.

Study 1 is structured in the following way. Firstly, the concept of persistence with behavioural change is established, then the paradigm of persistence with behavioural change is introduced and compared to similar tasks from previous literature. Secondly, the paradigm is described in detail, including the results from pilot studies that justify the chosen parameters for the length of time and reward values. Apart from testing how people behave whilst working on the paradigm, an experimental manipulation is introduced to illustrate how the task could be used. Lastly, after presenting the findings, possible applications of the paradigm, and ways to test its validity are suggested.

## *Chapter 4: The Influence of Immediate Context on the Trait Mindfulness Questionnaire (Study 2)*

Chapter 4 includes the second study of the thesis. Research in this study was initially performed to test the relationship between persistence with behavioural change and mindfulness in a controlled, laboratory environment. Mindfulness is thus induced briefly before participants start working on the paradigm of persistence with behavioural change. In order to induce mindfulness, an existing mindfulness body-scan meditation recording is applied. A control condition recording inducing a mind-wandering state is designed for the experiment. A mindfulness trait questionnaire is also

used to test for stable characteristics of mindfulness. Whilst investigating this relationship, some unexpected findings were identified regarding the trait mindfulness questionnaire. Two possible explanations are offered and tested for in a further experiment by adjusting the position of the questionnaire. The results from this experiment are presented and possible implications are suggested.

## *Chapter 5: The effectiveness of "brief mindfulness induction": A review and evaluation (Study 3)*

Chapter 5 presents the last study of this thesis – Study 3. Study 3 was developed from questions that arose whilst working on Study 2. These questions concerned the effectiveness of the brief mindfulness induction methodology. The methodology is firstly introduced and described. Then a literature review of previous studies applying brief inductions is conducted. The focus of the literature review is to assess the numerous methodological aspects used in each study such as the length, type, and content of inductions, manipulation checks, or the amount of meditation experience participants have. A results section follows, with summaries of findings. A description of the findings for each study is included in the appendix. The last part of the study narrows the focus to two methodological aspects - the content and length of brief inductions. Both aspects are discussed in detail. Specifically, the key question for the content of brief mindfulness inductions is how such content fits with previously proposed mindfulness conceptualisations. The main query for the length of brief inductions is how long they should be to induce a state of mindfulness comparable to mindfulness assessed by other methods. The study closes with suggestions for improvements to the brief mindfulness induction methodology.

## *Chapter 6: Conclusion*

The final chapter first summarises the studies included in the thesis and then describes the contributions they make to research and practice. The chapter ends with suggestions of how future studies can expand on current findings.

# Summary

To summarise, the present work is a three-study format thesis. The thesis consists of six chapters which assess the construct of mindfulness, its measurement, and influence it has on persistence with behavioural change. The paradigm of persistence with

behavioural change that is designed in Study 1 captures and measures persistence with behavioural change. The way persistence with behavioural change is affected by mindfulness as well as what methodological issues arise by measuring mindfulness via standard means is the subject of Study 2. Methodological questions about one of the mindfulness methods, brief mindfulness induction, are further discussed in Study 3, which also provides a literature review of previous studies applying this method. The thesis concludes with listing its contributions, future research suggestions and implications.

# Chapter 2

# Background Literature Review

## The mindfulness concept

Mindfulness has become popular in recent years in Western culture, although its roots originate in modern Buddhism, particularly in traditions of Theravada Buddhism (Dorjee, 2010). Before explaining how mindfulness is conceptualised in the Western culture, it is important to describe its meaning within Buddhism, especially Theravada Buddhism, in order to understand the context in which the modern construct of mindfulness has its roots, as well as the comparison between the two interpretations. The reason why such a comparison is necessary is because there are multiple understandings of mindfulness in both schools. Not reaching a consensus of what mindfulness means then results in difficulties with designing measures of mindfulness as well as interpreting scientific findings. The following sections therefore focus on explaining the meaning of mindfulness within the Theravada Buddhist tradition, then the understanding of mindfulness in Western culture is explained, followed by a comparison between these two conceptualisations.

### *Mindfulness in the Theravada Buddhist tradition*

Mindfulness was translated from the Pali word 'sati', which could be understood as 'to remember', supposedly to maintain awareness (Grossman & Van Dam, 2011). In Theravada Buddhism, mindfulness is one of the eight interrelated components of the Eightfold Path. The Eightfold Path is the last one of the Four Noble Truths. The Four Noble Truths and the Eightfold Path are the key principles of Theravada Buddhism where the former is primarily concerned with doctrine and the latter with practice, and together they are known as Dhamma[1] (Bodhi, 1998). The Four Noble Truths are as follows: i) all life involves suffering; ii) suffering originates in desires; iii) the cessation of desires ends suffering; iv) in order to cease desires, one has to follow the Eightfold Path (M. S. Christopher, Charoensuk, Gilbert, Neary, & Pearce, 2009). The Eightfold Path offers practical tools to develop one's knowledge, understanding and wisdom in order to cease suffering by liberating oneself from the cycle of rebirth (Bodhi, 1998). Before focusing on mindfulness as it was described in the Eightfold Path, the context

[1] Also known as Dharma.

within which it is positioned is reviewed in order to clarify the later comparison with the Western understanding of mindfulness.

Bodhi (1998), a Theravada Buddhist monk, described the components of the Eightfold Path accordingly. The first component, right view, is the ability to distinguish between the wholesome, i.e. morally right (e.g. benefiting all, gentleness, wisdom) and the unwholesome, i.e. morally wrong (e.g. causing suffering, greed, aversion). The second component, right intention, concerns intentions to let go of any attachment, have a good will and be harmless. The intention of harmlessness is practised by meditation during which one contemplates the actual suffering of people one is angry with, whilst realising that they also wish to be free from suffering like anyone else. Hence this practice strengthens one's compassion. The intention of good will is enhanced by loving-kindness meditation. The third component, right speech, is focused on avoiding speech which is false, slanderous, harsh or idle, whilst the fourth component, right action, omits hurtful actions such as taking life, stealing, or sexual misconduct. The fifth component, right livelihood, avoids harmful professions like working in the war industry or meat production. The sixth component, right effort, is about focusing energy on wholesome states like concentration, self-discipline, and kindness in order to diminish unwholesome states, evoking wholesome states and trying to maintain them. The seventh component, right concentration, is to place the whole attention on one object of the external or internal world (e.g. focusing on colour, breathing, joy, etc.). Yet this kind of concentration is based in wisdom, hence cannot be associated with unwholesome, i.e. morally wrong, states. For instance, although focusing on killing an enemy is a form of concentration, this act could not be labelled as 'right concentration' as it involves ethically unwholesome states such as causing suffering or harming others.

The eighth component of key importance here is right mindfulness. Again the 'right' quality implies the strong link of mindfulness to the ethical foundations of Buddhism. Bodhi (1998) states that right mindfulness is a present-moment experience that leads to deep concentration and insight. Deep concentration, which can be called 'momentary concentration' is characterised by being focused on multiple objects, all of which are present in the current moment as well as being aware of their constant changing nature. Insight is reaching Dhamma, the truth or wisdom; this reaching of wisdom is not intellectual but non-conceptual, based in experience. The presence of insight is the key feature differentiating right mindfulness from right concentration. Right mindfulness is practised by four foundations. The first foundation is contemplation on body, for

instance being mindful of breathing, current postures or transition from one posture to another. The second foundation is contemplation of feelings, concretely learning to note what feelings appear in the current moment, later observing their impermanence as they continually rise and fade. Similarly, observing the instability of the state of mind where thoughts change from moment to moment, is the third foundation of the practice of right mindfulness. The last contemplation is that of Dhamma, including the Four Noble Truths or hindrances leading to unwholesome states. The important feature of the four foundations is to be able to discern whether the present action is or is not in line with wholesome states. Hence mindfulness is not free of judgment (Purser & Milillo, 2015).

To conclude, within the Theravada Buddhist tradition, mindfulness is one of the eight components of the Eightfold Path. The Eightfold path together with the Four Noble Truths form the foundations of Buddhist teaching. Buddhist mindfulness is called "right mindfulness" as it is tightly connected to the ethical dimension of Buddhism of distinguishing between the unwholesome and wholesome states whilst cultivating the latter. It involves profound concentration of what is in one's awareness at each precise moment as well as insight about one's experience based in universal wisdom, Dhamma. Mindfulness is practised by meditations placing the attentional focus on body, feelings, mind, and Dhamma.

## *Mindfulness in the West*

Buddhist mindfulness meditation practices focusing on body, feelings and mind inspired the introduction of a programme called Stress Reduction & Relaxation Program[2] at the University of Massachusetts Medical Center in the late 1970's, resulting in a growing interest in mindfulness amongst mainstream scientific and medical communities (J. Mark G. Williams & Kabat-Zinn, 2011).

In the late 1970's, Buddhist meditative practices inspired the introduction of a programme called Stress Reduction & Relaxation Program[3] at the University of Massachusetts Medical Center, resulting in a growing interest in mindfulness amongst mainstream scientific and medical communities (J. Mark G. Williams & Kabat-Zinn, 2011). Mindfulness has been described as "the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment" (Kabat-Zinn, 2003, p. 145). In order to describe the

[2] In the 1990's, the program was renamed to Mindfulness-Based Stress Reduction (MBSR).
[3] In the 1990's, the program was renamed to Mindfulness-Based Stress Reduction (MBSR).

main features of mindfulness and guide the development of measurement tools, several detailed conceptualisations have been suggested. The following section will introduce three such conceptualisations, which are widely used in mindfulness literature.

The first conceptualisation was based on consensus amongst experts in the field of mindfulness (Bishop et al., 2004). Mindfulness was labelled as a type of meta-cognition (i.e. cognition about cognitions) that consists of two components: self-regulation of attention and orientation towards one's experience. The first component involves present-moment awareness with the following processes: sustained attention (enables a vigilant, monitoring state and detection of distractions such as thoughts, feelings, or bodily sensations), attention switching (i.e. going back to the present moment after detecting a distraction), and cognitive inhibition (i.e. abandoning further engagement in thinking after noticing a distraction). Engaging these processes widens one's perspective and opens it to novel information as the mind is not preoccupied by elaborate thinking which commonly happens in a non-mindful state. The second component of mindfulness includes a particular approach towards the present moment experience described by the first component. This approach involves attitudes like curiosity, openness, or acceptance. Curiosity is an interest in what is happening in one's awareness, for instance, where the mind wanders. Openness is welcoming anything that enters the present moment and acceptance is letting go of a need to have a different experience. Mindfulness is practised not only by meditation but can be applied to everyday tasks like walking or interacting with people.

The attitudinal component is not included in the conceptualisation of mindfulness by Brown and Ryan (2004). The authors argue acceptance is embedded in the attentional dimension. Originally, they included the factor of acceptance in the testing of their trait mindfulness scale, the Mindfulness Attention Awareness Scale (MAAS), but acceptance did not lead to a better explanation of mindfulness (Brown & Ryan, 2003). On the other hand, the authors extended the attentional dimension by arguing it consists of two distinct factors: attention and awareness. Whilst awareness is experience of internal stimuli (apperception) or external stimuli (perception), attention is a specific focus on an aspect of that experience. The authors further stated both awareness and attention are dimensions of consciousness alongside cognition, emotions and motives. Characteristics of attention and awareness were described, including clarity of awareness, non-conceptual awareness, flexibility of awareness and attention, empirical stance towards

reality, present-oriented consciousness, and stability or continuity of attention and awareness (Brown, Ryan, & Creswell, 2007).

The last western conceptualisation discussed here is that of Shapiro, Carlson, Astin, and Freedman (2006). These researchers introduced a model of mindfulness consisting of three inter-connected axioms of mindfulness: intention, attention, and attitude. In other words, the axioms can be described as i) on purpose, ii) paying attention, iii) in a particular way. The first axiom, intention, characterises reasons to practise mindfulness. The intention set in the west depends on each individual. For some it may be dealing better with stressful situations, whilst for others it may mean a kinder attitude to others. Such intentions are dynamic and can change with ongoing practice. The second axiom of the model, paying attention, is characterised by sustained attention, attention switching, and cognitive inhibition. The last axiom, attitude, includes qualities such as kindness, curiosity, openness, patience, compassion, not-striving, equanimity, and acceptance. The authors argue that practising mindfulness via the three axioms leads to a shift in perspective called 'reperceiving'. This shift could be described as seeing the present moment in a clearer, more objective way (Shapiro et al., 2006).

To conclude, several conceptualisations of mindfulness have been proposed. This section discussed the three most prominent ones. Bishop's et al. (2004) conceptualisation shares the focus on attention and attitude with Shapiro's et al. (2006) model. Shapiro et al. (2006) also add to the model the dimension of purposefulness characterising mindfulness as well as explain what mechanism of change may be associated with mindfulness practice. Brown and Ryan's (2004) definition of mindfulness is somehow different from the other two conceptualisations as it does not place a significant importance on the attitudinal dimension. This definition also treats attention and awareness as two distinct components of mindfulness (Brown & Ryan, 2003).

## *Comparison between Buddhist and Western understanding of mindfulness*

Although the Western concept of mindfulness originates in its Buddhist counterpart, there are more differences than similarities between the two constructs. The following section will first focus on what the concepts have in common and then will discuss what differentiates them.

According to Dorjee (2010), dimensions that are shared between mindfulness as it is taught in the West and mindfulness originating in Buddhist traditions are attentional control, bare attention (i.e. initial attention before creating further concepts about the experience), and meta-awareness. Similarly, Feldman, Hayes, Kumar, Greeson, and Laurenceau (2007) listed shared dimensions between the two conceptualisations, including emotion regulation, higher flexibility, less over-engagement (e.g. rumination), or less under-engagement (e.g. thought suppression or experiential avoidance). Examining similarities from a different perspective, there is a lack of consensus in both the Western and Buddhist understanding of mindfulness. The different views on mindfulness in the West were discussed in the previous section. In Buddhism, there are many schools drawing from numerous Buddhist texts, each offering a particular view on mindfulness (Kang & Whittingham, 2010). The views are not mutually exclusive but are distinct to an extent. Thus in Buddhism there is also not complete consensus of what constitutes mindfulness (Grossman, 2008).

Narrowing the focus on the interpretation of mindfulness offered by Theravada Buddhism from which the Western mindfulness originates, there are some key differences between this construct and its Western counterpart.

(1) Insight is a key characteristic of Buddhist mindfulness (Bodhi, 1998). Conversely, insight is not mentioned in Western definitions of mindfulness. Yet Ireland (2013) argued that even Western mindfulness has its form of insight which is a change in understanding of what leads to dysfunction. For instance, with enhanced present moment awareness, one gains insight about the downward spiral of ruminating thoughts.

(2) Attention and awareness are crucial components to the Western concepts of mindfulness. In Buddhist traditions, attention and awareness are preconditions to mindfulness but not mindfulness itself (Chiesa, 2013).

(3) Similarly to the previous point, attitudes, which form the other important dimension of mindfulness in the West, are not part of mindfulness in Buddhism but belong to its wider practice (Grabovac, Lau, & Willett, 2011).

(4) A non-judgmental feature of mindfulness is stressed in Western mindfulness whereby negative states like anger or jealousy are taught to be accepted (Kang & Whittingham, 2010). In Buddhism, such negative states are aimed to be removed via

wise attention, volition, or emotion, implying a discerning nature of mindfulness (Kang & Whittingham, 2010).

(5) In Theravada Buddhism, mindfulness and concentration are separate concepts, although not exclusive as mindfulness involves aspects of concentration (Bodhi, 1998). In the West, there is no consensus about the involvement of concentration in mindfulness. The opinion ranges from mindfulness and concentration being completely separate constructs (Lutz, Slagter, Dunne, & Davidson, 2008), mindfulness being more about concentration (Grabovac et al., 2011) or lacking this dimension (Mikulas, 2011), to both concepts being used interchangeably (Chiesa, 2013).

(6) There are differences in intention behind mindfulness practice. Whereas in Buddhism, the intention is freeing one from suffering (Bodhi, 1998), in the West the goal of mindfulness is more individual (Shapiro et al., 2006), often focused on symptom reduction (Grabovac et al., 2011).

(7) The perspective on the states of awareness differs. Whilst in the West, a state can be either psychologically normal or dysfunctional, in Buddhism, even the normal state is considered to be deluded as people lack awareness of it (Grossman, 2010).

(8) The last difference between Buddhist and Western understandings of mindfulness highlighted here is that of ethics. Buddhist understanding of mindfulness is strongly connected to ethics described in Buddhist teachings (Chiesa, 2013). On the other hand, in the West, ethics are not explicitly stated but are assumed to be implicitly inherent in teachings of mindfulness (Stanley, Purser, & Nirbhay, 2018). For instance, during mindfulness courses, a teacher can embody ethics of mindfulness by being compassionate.

Although sharing the same origin, Western mindfulness has evolved to be a rather different concept to its Buddhist counterpart. The key differences are based in the presence and understanding of insight, non-judgmental nature, relation to concentration, and incorporation of ethics. Nevertheless, both concepts share a similar difficulty of not reaching a consensus of what exactly constitutes mindfulness. This is problematic, particularly for the Western understanding of mindfulness as it treats this concept as a scientific one. This means that the lack of consensus impacts the development of measurement tools as well as multiple interpretations being labelled as mindfulness in research literature.

## *Connection to the present thesis*

The issue of multiple definitions of mindfulness and how it influences one of the ways of assessing mindfulness - brief mindfulness inductions – will be discussed and some suggestions will be offered in Study 3.

# Standard methods for assessing effects of mindfulness

Since mindfulness was introduced in scientific circles, a number of methodologies have been developed to provide experimental evidence supporting this construct. Most commonly, a state of mindfulness is induced or a degree of mindfulness is measured by mindfulness questionnaires. Both ways will be reviewed here and their connection to the present thesis will be explained.

## *Mindfulness inductions*

The rationale of mindfulness inductions is to evoke the state of mindfulness and measure its effect on dependent variables. This has been done by either mindfulness programmes or brief mindfulness exercises. The most commonly known mindfulness programmes are Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn, 1982), Mindfulness-Based Cognitive Therapy (MBCT; Segal, Williams, & Teasdale, 2012), and Mindfulness-Based Relapse Prevention (MBRP; Bowen, Chawla, & Marlatt (2011). Each programme focuses on a specific psychological issue. The duration of the programmes is 8 to 10 weeks during which a group of participants meet in weekly 1.5 – 2 hour long sessions. Self-responsibility is stressed via working on various tasks at home for around 45 minutes per day (e.g. mindfulness meditations, reflections, reading, etc.). The programmes also emphasise a non-goal orientation as the main focus is on developing non-judgmental awareness of the present moment and hence striving to achieve is not relevant. Various forms of mindfulness meditations appear in the space of 8 weeks, particularly breathing and body-scan meditations. The lessons also include topics like mindfulness in everyday tasks, present-centred attention versus automatic pilot, dealing with difficult emotions and thoughts, responding versus reacting, and approaching situations with acceptance. Despite shared similarities, each programme has its specific focus and themes covered. MBSR consists of topics relating to the area of stress (e.g. fight and flight response, relaxing to counter autonomic arousal, etc.),

pain management (e.g. focusing on pain, or focusing on pleasant experience), and interaction with people (e.g. communication or compassion) (Kabat-Zinn, 1982). MBCT comprises themes of self-compassion and kindness, recognising one's aversion, self-care, and planning to prevent future return to depression (Segal et al., 2012). MBRP includes topics of cravings, high-risk situations to relapse, relapse, and self-care (Bowen et al., 2011).

Some criticism has been raised about mindfulness programmes. For instance, Farb (2012) argued that people are likely to attend the programmes with a certain degree of expectations about what the intervention should provide for them. This could then confound the measurement of the efficacy of the programme. Furthermore, Dobkin, Irving, and Amar (2012) stated that MBSR might not be suitable for everyone but the instances of possible adverse effects are not recorded in a systematic way. This could also be relevant to MBCT and MBRP. Lastly, Davidson (2010) pointed out that it is difficult to capture by self-reports how mindfulness is practised by attendees outside the class. For instance, attendees may not include all the instances in which they used mindfulness methods (Davidson, 2010). Not being able to assess mindfulness in a controlled experiment might have prompted researchers to start applying the brief mindfulness inductions method.

The brief mindfulness induction is an experimental manipulation whereby mindfulness is briefly induced during an experimental session and its effects on a dependent variable are compared with a control condition (e.g. Arch & Craske, 2006; Erisman & Roemer, 2010). The way of inducing mindfulness is generally by a mindfulness meditation like mindfulness of breath (e.g. Adams et al., 2013), body scan (e.g. Ostafin & Kassman, 2012), or mindfulness of thoughts (e.g. Pepping, O'Donovan, & Davis, 2013). The control condition comprises of tasks simulating a non-mindful state like rumination (e.g. Broderick, 2005) or listening to a story (e.g. Marchiori & Papies, 2014). Brief mindfulness inductions are usually induced in one setting during 3 (Reb & Narayanan, 2014) to 45 minutes (Bonamo, Legerski, & Thomas, 2015). In some studies, brief mindfulness inductions were used alongside a mindfulness programme to compare the effect and strength of state mindfulness before and after the intervention (e.g. Lush et al., 2009). As brief mindfulness induction is a fairly recent method for assessing the effects of mindfulness (the oldest Study I could trace is by Broderick (2005)), a review and evaluation of this method will be useful.

## *Connection to the present thesis*

A literature review of the brief mindfulness induction is conducted in Study 3 where experiments applying this method are identified and individual methodological aspects such as the type or length of inductions are compared across different studies. As far as I am aware, this has not been done before, therefore Study 3 could add further knowledge to the mindfulness methodology literature. The Study also addresses possible issues with the brief mindfulness induction methodology, particularly the length of brief mindfulness inductions, i.e. whether a short induction can or cannot induce mindfulness, and content of mindfulness inductions, i.e. what information is included in inductions and how it maps onto existing conceptualisations.

## *Mindfulness questionnaires*

There are two types of mindfulness self-report questionnaires: trait and state, where the former assesses stable and the latter temporary characteristics of mindfulness (Bergomi, Tschacher, & Kupper, 2013). Regarding the trait mindfulness questionnaires, the following seven scales are commonly used.

(1) The Cognitive and Affective Mindfulness Scale – Revised (CAMS-R) consists of 12 items that create one single score (Feldman et al., 2007). The items can be used to assess clinical populations, are formed as ability or willingness of being mindful, and measure attention, present focus, awareness, and acceptance of thoughts and feelings (Feldman et al., 2007).

(2) The multi-dimensional Five Facet Mindfulness Questionnaire (FFMQ) by Baer, Smith, Hopkins, Krietemeyer, and Toney (2006) includes 39 items which were selected from a pool of 112 items from other mindfulness scales. The items are divided into five facets: i) nonreactivity to inner experience, ii) observe, such as observing, noticing, and attending to sensations, perceptions, thoughts, or feelings, iii) acting aware, including acting with awareness, automatic pilot, concentration, and nondistraction, iv) describe, i.e. describing and labelling with words, and v) nonjudging of experience. The scale is suitable for the general population.

(3) The Freiburg Mindfulness Inventory (FMI) consists of four factors: insight, mindful presence, non-judgmental acceptance, and openness to experiences (Walach, Buchheld, Buttenmüller, Kleinknecht, & Schmidt, 2006). The questionnaire is not suitable for the general population, but more for those experienced with mindfulness or Buddhist concepts (Bergomi et al., 2013).

(4) The Kentucky Inventory of Mindfulness Scale (KIMS), comprises 39 items divided into four facets: accepting without judgment, acting with awareness, describing, and observing (Baer, Smith, & Allen, 2004).

(5) The Mindfulness Attention Awareness Scale (MAAS) (Brown & Ryan, 2003). The scale is uni-dimensional, assessing attention and awareness. It does not focus on attitudes like acceptance or empathy and all its items are negatively framed (e.g. "I find it difficult to stay focused on what's happening in the present") (Brown & Ryan, 2003).

(6) The Philadelphia Mindfulness Scale (PHLMS) includes the attitude of acceptance as one of the two main factors (Cardaciotto et al., 2008). The other factor is awareness and the scale consists of 20 items in total (Cardaciotto et al., 2008).

The KIMS, MAAS, and PHLMS are all used for the general population, although the items of the KIMS are strongly influenced by Dialectic Behaviour Therapy (Bergomi et al., 2013).

(7) The Southampton Mindfulness Questionnaire (SMQ) is a 16 item scale that measures people's approach towards distressing images and thoughts (Chadwick et al., 2008). The questionnaire is uni-dimensional and consists of four bipolar constructs that are related: i) decentred awareness of cognitions vs. being lost in reacting to cognitions, ii) allowing attention to be present to difficult cognitions vs. experiential avoidance, iii) acceptance of cognitions and self vs. judging them both, and iv) not reacting to cognitions vs worrying or ruminating (Chadwick et al., 2008). The scale is suitable for clinical populations (Bergomi et al., 2013).

Regarding state mindfulness questionnaires, two have been developed. The first state questionnaire is a short version of the MAAS (Brown & Ryan, 2003). The second questionnaire is the Toronto Mindfulness Scale (TMS) which assesses two factors: curiosity and decentering, hence focusing on the attitudinal but not attentional dimension (Lau et al., 2006).

A number of issues have been identified with mindfulness questionnaires. The first issue taps onto the previous discussion. Specifically, due to the lack of consensus about what constitutes mindfulness, it is not entirely certain what factors should be included in mindfulness questionnaires or whether the questionnaires should be uni- or multi-dimensional (e.g. Bergomi, Tschacher, & Kupper, 2013). The background of each questionnaire differs. Some questionnaires have been developed to suit a particular

therapy (e.g. the KIMS), other questionnaires were inspired by Theravada Buddhism (e.g. the FMI) or designed from Western definitions (e.g. the PHLMS). Grossman and Van Dam (2011) pointed out discrepancy between different questionnaires, stating that what is measured by the whole MAAS is included only as one of many factors in the FFMQ (the 'act with awareness' subscale), yet both scales are supposed to measure the same construct of mindfulness. Indeed, correlations between different mindfulness scales range from only .30 to .60 (Grossman, 2011).

The second issue with mindfulness questionnaires is that, at present, there is no good way to validate them with an objective measure (Davidson, 2010). For instance, a brain region or behaviour unique to mindfulness has not yet been identified (Grossman, 2011).

The third issue is social desirability bias (Bergomi et al., 2013) and the effect of the individual aspirations of those who have been practising mindfulness (Grossman, 2011).

Fourthly, if mindfulness consists of several components as it is suggested by many researchers, it is unclear how they sum up together, especially as the components might not be independent of one another (Chiesa, 2013). If a significant relationship is found for one of the components, can a conclusion be made about mindfulness as a whole? Chiesa (2013) recommends that research should focus on separate characteristics of mindfulness as opposed to trying to capture the whole construct.

Fifthly, there is a lack of clarity about semantic understanding of the questionnaires. These may stem from different reasons. One such reason is that secular understanding of mindfulness is different from Buddhist traditions (e.g. Grossman, 2008). Indeed it has been shown experimentally that Buddhist monks rate their mindfulness to a similar level as Western participants inexperienced in practising mindfulness (M. S. Christopher et al., 2009). Focusing on mindfulness in the West, experienced meditators might not understand mindfulness the same way as those who have little or no experience with mindfulness (Davidson, 2010). Grossman (2008) questioned how accurately inexperienced meditators assess their levels of mindfulness on the questionnaires. He argued that many of the items presented in questionnaires are basic, hence may seem to be easy to do. For those who are inexperienced, it may be difficult to even realise that they are not mindful (Chiesa, 2013). Thus meta-consciousness about mindfulness can differ from the actual levels of mindfulness (Brown et al., 2007). It

may also be challenging to describe in language a concept that is understood to be about non-conceptual awareness (Stanley, 2012).

The last issue of mindfulness questionnaires discussed here is that opinion differs on whether mindfulness has trait-like or state-like qualities. According to the Buddhist perspective, nothing is stable which would suggest that there is no such a thing as a mindfulness trait (Grossman, 2010). Purser and Milillo (2015) argued that mindfulness is not inherent and requires practice, hence cannot be understood as a trait. Bishop et al. (2004) pointed out that as mindfulness requires moment to moment regulation of attention, it has more state-like qualities. To support these claims, Giluk (2009) conducted a meta-analysis of previous studies and found trait mindfulness to be stronger with the amount of practice, suggesting it is more likely a composite of acquired skills as opposed to a trait. Nevertheless, mindfulness trait questionnaires are the most common way of mindfulness measurement (Bergomi et al., 2013).

To conclude, several questionnaires have been developed to measure both state and trait mindfulness. The questionnaires consist of a differing number of items and dimensions. Some questionnaires are uni-dimensional and others are multi-dimensional. The scales also differ in their suitability for specific populations, including general, clinical, and meditator samples. Although assessing mindfulness with questionnaires is common, some difficulties with this method have been identified, ranging from the lack of consensus with mindfulness conceptualisation, issues with semantic understanding, to uncertainty over whether mindfulness can be considered as inherent trait.

## *Connection to the present thesis*

The problem of the stability of mindfulness trait questionnaires will be addressed by providing some new experimental data in Study 2. The findings of Study 2 will also include discussion about the differences between meta-mindfulness and actual mindfulness, particularly in inexperienced meditators.

# Effect of mindfulness on behavioural change

Mindfulness and its effect has been examined in various domains, including behavioural change. Behavioural change, in particular relapse prevention of addictive behaviours, has been a key interest of the MBRP programme (Bowen et al., 2011). This programme

combines knowledge from mindfulness and Marlatt and Gordon's Relapse Prevention model (Larimer, Palmer, & Marlatt, 1999).

The Relapse Prevention model discusses factors related to relapse as well as ways of avoiding it. Regarding the factors leading to relapse, immediate determinants and covert antecedents were described. Immediate determinants include high-risk situations (e.g. negative emotional states or exposure to addiction cues), coping skills, outcome expectancies (beliefs about the function of a drug in high-risk situations), and abstinence violation effect (reaction of a person influencing whether lapse will lead to relapse). Covert antecedents comprise lifestyle imbalance (e.g. lack of positive experience), and urges and cravings (mediated by conditioning and beliefs). In order to prevent relapse, the model offers training one's skills (e.g. coping with high-risk situations), restructuring cognition (enhancing self-efficacy or reducing myths about the addictive behaviour), and lifestyle balance (e.g. finding activities inducing positive affect). In essence, clients learn the factors of the model and ways of dealing with each of them (Larimer et al., 1999).

In the MBRP, information about various aspects of relapse as they were explained in the Relapse Prevention model is described (Bowen et al., 2011). Specifically, the connection between habitual, mindless behaviour and relapse is pointed out, triggers, cravings, and high risk situations are discussed, skills for responding to high-risk situations are offered, and balancing one's lifestyle is suggested. The programme also teaches the relativity of thoughts, which may be helpful in dealing with rumination or counterproductive beliefs. Mindfulness practice is encouraged not only in formal meditations but also during day to day activities. The importance of social support and maintaining mindfulness practice in order to avoid relapse concludes the programme (Bowen et al., 2011).

There is growing evidence supporting the efficacy of MBSR for those suffering from substance abuse, particularly at follow ups occurring months after the treatment. Specifically, MBSR showed lower scores on self-reported substance use and cravings 4 months later (Bowen et al., 2009). Moreover, ratings of relapse, which were in line with a urine drug screen test in the majority of participants, were decreased at a 12-month follow up compared to other therapies (Bowen et al., 2014). A urine drug screen test showed reductions in stimulant use in those with reported mood and anxiety disorders 1 month after the end of the programme (Glasner et al., 2017), and in another study,

MBSR participants reported lower levels of cravings at the end of the intervention and 2 months later (Zemestani & Ottaviani, 2016). Hence MBSR seems to lead to improved self-reported and objective outcomes in behavioural change as well as its maintenance in clinical samples.

The link between behavioural change and mindfulness has also been assessed by other methods. Li, Howard, Garland, McGovern, and Lazar (2017) listed further programmes incorporating mindfulness that were applied to assess its effect on substance use, e.g. MBSR, the Vipassana meditation course, Mindfulness-oriented recovery enhancement, etc. Trait mindfulness questionnaires were also used to examine the relationship. For instance, Black, Sussman, Johnson, and Milam (2012) applied the MAAS scale and found that trait mindfulness moderated the relationship between intention to smoke and smoking frequency. Further studies found that trait mindfulness was negatively correlated with alcohol use (Black, Semple, Pokhrel, & Grenard, 2011) and severity of dependence (Bowen & Enkema, 2014). Another way in which the relationship between mindfulness and behavioural change was examined was via the method of brief mindfulness induction. As Li et al. (2017) pointed out, the results from the studies applying this method were mixed. Positive results were reported by Ussher, Cropley, Playle, Mohidin, and West (2009), namely desire to smoke and withdrawal symptoms were lower after a 10-minute mindfulness body-scan meditation. On the other hand, null-findings were noted in a study assessing the effect of a mindfulness-based strategy on alcohol cravings (C. M. Murphy & MacKillop, 2014).

To summarise, the effect of mindfulness on behavioural change has been assessed by multiple methods, including mindfulness programmes, particularly the MBRP, questionnaires, and brief mindfulness inductions. Although the effect of the MBRP on substance abuse, especially its maintenance, has been found for both self-reported as well as objective measures, it is not entirely certain, given the concerns raised about assessing effects of mindfulness by mindfulness programmes, whether these findings could be explained by mindfulness or be attributed to other factors instead, for instance suggestion or social support (e.g. Farb, 2012). The influence of some of these factors, especially social support, could be minimised by inducing mindfulness in a controlled setting using the brief mindfulness induction method. Yet studies applying this method led to mixed findings. Further the studies applying the brief induction method focused on self-reported dependent variables from applied behavioural change (i.e. alcohol and

cigarette use), hence it could be useful to test the effect of brief mindfulness on objective variables of general behavioural change.

## *Connection to the present thesis*

There are several gaps in the research concerning mindfulness and behavioural change that will be addressed by Study 2. In Study 2, a brief induction in a laboratory setting will be applied that should reduce the influence of other factors like social support in mindfulness programmes. Additionally, mindfulness will also be examined by a trait mindfulness questionnaire to allow the comparison of its findings to the brief induction. Behavioural change will be assessed by a paradigm of persistence with behavioural change that is developed as a novel methodology in Study 1. The paradigm allows objective measurement of behavioural change as all participants have an option to learn a new behaviour that is advantageous in the long-term, although difficult in the short-term, requiring a degree of persistence. All of this is a typical dilemma people have to face whilst switching to a novel behavioural option. This dilemma is assumed to be present in various contexts, hence the scope of behavioural change addressed by the paradigm is wider than in previous mindfulness studies. Thus measuring the effect of mindfulness on a simulated behavioural change may serve as a useful addition to the current literature investigating this relationship. The paradigm itself provides a novel task for measuring the process of initial behavioural change by objective means.

# Chapter 3

# Paradigm of Persistence with Behavioural Change (Study 1)


## Abstract

In order to succeed with some types of behavioural change, persistence is crucial. Persistence with behavioural change is a repeated decision to continue with a novel, frustrating behaviour without returning back to the habitual behaviour in order to achieve better outcomes in future. To capture persistence with behavioural change, a new experimental paradigm is introduced. The paradigm consists of a series of choices between a habitual and novel key to response mapping whilst completing computerized paths in a maze. The optimal strategy, which is known to participants, is to persist with the novel option. The results showed high individual differences in strategies applied ranging from always staying with the habitual behaviour, returning back to it (relapse), to persisting with the novel alternative. Moreover, the study demonstrated the paradigm application by manipulating the habitual value to simulate a real world phenomenon. Further applications were presented as well as suggestions for testing construct validity. The paradigm could become a useful tool for behavioural change research, complementing existing measures.


## Introduction

Imagine a situation where you are presented with a choice between following a familiar or an unfamiliar pattern. The familiar pattern, which could also be called habitual, leads to rewards. The unfamiliar option brings no positive outcomes, and relative to the habitual alternative results in losses. In this case, choosing the former option is likely. Normally, we follow our 'habits'—and we are typically right to do so, as such habits have often arisen through learning effectively to deal with everyday tasks and are associated with lower levels of stress (Wood, Quinn, & Kashy, 2002).

Yet what if the same familiar pattern results in negative consequences compared to its counterpart at an unknown point in future as it is, for example, the case with substance abuse (e.g. Lopez, Collishaw, & Piha, 1994)? The preference of the familiar option is no longer as certain. Should one enjoy the present effects but possibly risk their negative consequences, or is it better to struggle now to improve prospective outcomes? How do we respond in a situation where breaking out of our current habit, and adopting a new habit, is the most effective strategy?

## *Defining persistence with behavioural change*

This kind of dilemma represents a specific type of behavioural change and is common in people's lives, specifically in situations when they are trying to shift from what may be seen as maladaptive habitual behaviour to new behaviour. At the time of the shift, the future benefits of the new behaviour are not yet felt, creating a situation strongly favouring the default option. This situation feels frustrating, especially before the new behaviour itself becomes habitual and easy to perform. The most effective way to form a new habit is to perform the desired behaviour repeatedly in a consistent manner (Lally, van Jaarsveld, Potts, & Wardle, 2009). Hence persisting with the new behaviour through this unpleasant period is necessary in order to complete the transition from habitual to new behaviour.

Persistence with behavioural change is switching to a novel behaviour whilst not returning back to the habitual behaviour during the initial, unpleasant phase of behavioural change. For example, consider a person who wishes to stop smoking. The smoker believes that not smoking will make him healthier in future. However when he actually stops smoking, he does not feel healthier: he feels worse. Changing one's behaviour represents many challenges (e.g. Kelly & Barker, 2016; Slopen et al., 2013). For instance, there are a number of withdrawal symptoms that not smoking brings like higher irritability, anxiety, or impatience (Hughes & Hatsukami, 1986). Despite these difficulties, the smoker has to make moment to moment decisions of not returning back to the habitual behaviour if she wishes to succeed in this pursuit. Such process was found to be hindered by factors like low confidence, self-efficacy, ability to self-monitor, or higher stress (Ockene et. al., 2000). Yet succeeding in this pursuit is extremely valuable as it brings both immediate and long-term health benefits to the person (e.g. Edwards, 2004; Kawachi, Colditz, & Stampfer, 1993). In order to succeed, the smoker needs to show a degree of persistence before benefiting from the change.

Persistence with behavioural change is a quality which might be inherent not only to the health domain. For instance, we may need to persist to learn to use a new program or gadget, or to react to unpleasant situations in a novel way. In order to capture this struggle, we have designed an experimental paradigm of persistence with behavioural change, which can measure the degree of persistence with behavioural change as well as how it is impacted on by various factors. Before introducing the paradigm further, the following section will focus on the comparison of persistence with behavioural change with other theoretically close concepts.

## Constructs similar to persistence with behavioural change

In the past literature, several concepts have been proposed which share a common ground with the construct of persistence with behavioural change: persistence, distress tolerance, learned industriousness, grit, behavioural maintenance, and self-control.

The first concept, persistence, originates from Cloninger's (1986) Unified Biosocial Theory of Personality where it acts as a subscale of the reward dependence dimension. Higher persistence indicates greater reward dependence, a tendency to react to rewards and learn to maintain rewarded behaviour; hence the more dependent people are on a reward the more likely they persist with a behaviour (Cloninger, Przybeck, & Svrakic, 1991). The second concept, distress tolerance, signifies coping with various forms of internal and external negative experience (Leyro, Zvolensky, & Bernstein, 2010). Being effortful despite various forms of aversion has been labelled as learned industriousness (Eisenberger, 1992), the third concept discussed here. Learned industriousness was applied to addictions where substance use was thought to be a type of low effort reinforcement (Quinn, Brandon, & Copeland, 1996). The fourth concept, grit, was defined as persistent effort despite failures or setbacks in one's progress (Duckworth, Peterson, Matthews, & Kelly, 2007). Factors that are key characteristics of grit are consistency of such effort and its long-term focus which can maintain behaviour whose benefits may only be evident after many years. The fifth concept, behavioural maintenance, is a quality of continuing with the changed behaviour. Some behavioural change models focused on behavioural maintenance as one of the stages of behavioural change (e.g. Prochaska & DiClemente, 1982; Schwarzer, 2008b), whereas other models aimed to list social factors like public policy or individual factors like coping skills that enhance behavioural maintenance (e.g. Kersell & Milsum, 1985; Larimer, Palmer, & Marlatt, 1999). The last concept, self-control, is "the capacity to regulate attention,

emotion, and behavior in the presence of temptation" (Duckworth & Gross, 2014, p. 319). Ainslie (1975) described issues with self-control as preference reversals between two alternatives: smaller-sooner and larger-later, where people may prefer the latter initially but then shift to the former as its reward becomes imminent.

There are several features the proposed concepts have in common with the construct of persistence with behavioural change. Persistence with behavioural change is reward dependent similarly to Cloninger's (1986) construct of persistence. For instance, a person who consistently believes not smoking makes him healthier may display stronger persistence with the new behaviour. Conversely, if the same person was given a terminal diagnosis, the motivation to persist would have been low. Further distress tolerance, learned industriousness, grit, as well as the current concept, focus on dealing with stressful, aversive situations. Moreover, it is assumed persistence with behavioural change can be altered. Similarly, Eisenberger (1992) argued learned industriousness can be increased by conditioning, Larimer et al. (1999) suggested relapse prevention strategies to enhance behavioural maintenance, whilst Ainslie (1975) and Skinner (1953) listed ways to improve self-control. Lastly, self-control and persistence with behavioural change deal with the choice between smaller-sooner and larger-later rewards. Both constructs are concerned with the mechanism of choosing the larger payoff whilst resisting the temptation of the smaller outcome.

Despite many similarities, there are some crucial differences between persistence with behavioural change and the other concepts. The main difference concerns the breadth of each construct. Firstly, Cloninger's (1986) persistence has a wider focus. In the context of the paradigm, Cloninger's persistence could be applied to the habitual behaviour as well as the novel alternative as both options can display reward dependency. Conversely, persistence with behavioural change relates to the novel behaviour only. Secondly, grit, behavioural maintenance, and self-control have a broader temporal focus than persistence with behavioural change. Whilst the current construct centres on the initial period of change when the new behaviour has not yet become habitual, grit focuses on goals which are years in distance and behavioural maintenance is concerned with the length of time in weeks, months, or years people are no longer engaged with the default behaviour. Similarly, self-control is required at any time point when one is presented with the choice between the smaller-sooner and larger-later. One of the further differences is the concept applicability. Some constructs are applied to a specific domain of behavioural change, for instance, the behavioural maintenance models focus

on health behaviour change (e.g. Conner, 2008; Kersell & Milsum, 1985) as opposed to general behavioural change. Other constructs are based on different areas of investigation. For example, grit, which was researched for its relation to performance and intelligence, has been linked more to achievement than changing one's behaviour (Duckworth et al., 2007). People may also be gritty but succumb to temptations, or vice versa (Duckworth & Gross, 2014). For example, a smoker who has relapsed every time she tried to give up his habit may relentlessly work towards completing her tenure. Hence, grit and persistence with behavioural change may or may not go hand in hand.

To summarise this section, persistence with behavioural change shares several characteristics with the concepts discussed above. Yet there are also key differences, particularly those related to the breadth of the focus and applicability of the constructs. Hence persistence with behavioural change can be considered as a theoretically new construct.

## *Paradigm of persistence with behavioural change*

We propose a paradigm of persistence with behavioural change. The paradigm involves completing paths with either a default key-to-response mapping, representing the habitual behaviour, or with a novel key-to-response mapping, depicting the new behaviour. People are presented with a number of trials, each requiring completion of one path. At the start of the trial they have to make a choice between the two behavioural modes. If they choose the novel key-to-response mapping, they can change their mind during the trial and return to the habitual behaviour, but not vice versa. Whilst the habitual behaviour is easy to perform, the new behaviour is difficult, especially at the beginning, and requires a degree of persistence through multiple failures before it starts resulting in positive outcomes. However succeeding in the new behaviour mode can lead to substantially larger outcomes, which is also explicitly stated to participants. The main advantage of the paradigm is that it enables us to measure the degree of persistence with behavioural change people exhibit as a number of trials on which people switch to the novel behaviour but do not relapse back to the habitual behaviour. Additionally, the paradigm enables investigation of the role various factors, both internal and external, have on persistence with behavioural change.

### Tasks similar to the paradigm of persistence with behavioural change

Several behavioural tasks have been proposed which, to an extent, resemble the paradigm of persistence with behavioural change or some of its features: Persistence

tasks, the IOWA gambling task, the Melioration task, and the Columbia card game. The following section will discuss their similarities and differences.

### *Persistence tasks*

Persistence tasks have been designed to measure concepts like distress tolerance or learned industriousness. The key variable in such tasks is the length of time a person carries on with an activity before terminating the trial. In case of assessing distress tolerance, the tasks are frustrating (Leyro et al., 2010). For instance, in the Mirror tracing persistence task, participants are asked to trace difficult geometric shapes as if viewed through a mirror (e.g. Matthews & Stoney, 1988) or in Anagram persistence task to solve difficult word puzzles (e.g. Brandon et al., 2003). Longer engagement in these tasks indicates greater persistence. Regarding the assessment of learned industriousness, the tasks involve varying or increasing intensity of physical or mental performance whilst measuring how long participants persist in such an activity (Eisenberger, 1992). For instance, Quinn (2010) trained people on one behaviour, then a different behaviour was introduced either with low or high effort (e.g. varied speed to perform). Subsequently, the first behaviour was assessed and the effort with which it was performed was measured, expecting higher performance, i.e. persistence, in the high effort group.

Persistence tasks and the paradigm of persistence with behavioural change measure endurance whilst working on difficult tasks. However the frustrating task in the paradigm eventually becomes easier if participants persist. On the other hand, typical persistence tasks do not cease to be difficult. Furthermore, whereas the paradigm presents a choice between two alternatives, each leading to a payoff, in persistence tasks, only continuing with the activity is rewarded.

### *The IOWA gambling task and melioration task*

Further tasks similar to the paradigm of persistence with behavioural change are the IOWA gambling task and the melioration task. The IOWA gambling task involves a series of choices from four decks of cards in order to maximise profit. The first two decks present high payoffs but higher penalties, whereas the other two decks contain smaller rewards but not as great penalties. Overall, it is more profitable to pick the decks with lower payoffs (Bechara, Damasio, Damasio, & Anderson, 1994). The melioration task, as the name suggests, involves measuring melioration, which is the tendency to pick the alternative that is less advantageous overall due to focusing on

outcomes per choice as opposed to their aggregates (Herrnstein, 1990). Tunney and Shanks (2002) demonstrated melioration in the experiments where two alternatives varied in the probability of payments. For the first alternative, the probability could increase from 0.33 to 0.99 with the proportion of responses given to the chosen option, whereas the probability for the second alternative would decrease from 0.99 to 0.33 the more responses were allocated to it. Despite a number of trials during which people could learn to maximise by choosing the option with the increasing probability, the suboptimal option was more popular (Tunney & Shanks, 2002).

The IOWA gambling task, the melioration task, and the paradigm of persistence with behavioural change include two options one of which is more advantageous overall, though the other may seem to be more beneficial at the beginning. Specifically, two decks with smaller payoffs in the IOWA gambling task, the increasing probability in the melioration task, and the novel behaviour in the paradigm represent the more advantageous alternative. However, there are some crucial differences between the tasks. Firstly, participants are not explicitly told what behaviour is optimal in the IOWA gambling and melioration tasks, whereas in the paradigm participants are informed that persisting previously led to higher rewards for the majority of people. Secondly, whilst in the IOWA gambling and melioration task the probability of payoffs is set by the experimenter, the paradigm requires the internal locus of control as the probability of succeeding depends on the performance of each individual. Thirdly, single payoffs for the less advantageous option relative to the more advantageous alternative vary where the former is larger in the IOWA task, equal in the melioration task, but smaller in the paradigm. Lastly, the levels of uncertainty between the options differ. The more advantageous option in the IOWA gambling task is also less risky, but in the paradigm, the advantageous behaviour bears higher risk as it is uncertain when it starts being rewarding. Further, whilst both alternatives in the IOWA gambling and melioration task involve uncertainty, only the novel alternative bears uncertain outcomes as the habitual option ensures predictable and safe payoffs.

### *Columbia card task game*

The last task reviewed here is the Columbia card task game (Figner, Mackinlay, Wilkening, & Weber, 2009). Although this task is quite different from the paradigm introduced here, it shares one important feature: the assessment of hot and cold states where the former simulates affective decision making and the latter deliberative

decision making (Figner et al., 2009). People are presented with a spread of 32 cards over a number of trials. Most cards include small gains but one to three cards also have large losses. In the cold state version, people decide how many cards they wish to turn over at the beginning of each trial. In the hot state version, people choose whether to continue after turning each card. If they pick a gain card, they can opt to continue, although turning a loss card terminates the trial. It is assumed that experiencing a win may affectively motivate people to continue, although it may be safer not to do so (Figner et al., 2009). The cold state in the paradigm of persistence with behavioural change is represented by opting between the habitual and novel behaviour at the beginning of each trial and the hot state by changing one's mind and going back to the habitual behaviour whilst working on the trial with the novel key-to-response mapping. This would likely be triggered by affective response to a failure to press the right key at one of the turns of the maze. Hence affective valence leading to a hot decision in the paradigm is negative which contrasts with the positive affect motivating continuation with the Columbia card task game. Unlike the Columbia card task game where participants are assigned to one or the other condition, the design of the paradigm enables measurement of both hot and cold decisions for each participant. The paradigm can also assess under which conditions people make affective decisions more likely, which could create an interesting addition to the Columbia card task game.

To summarise, although the paradigm of persistence with behavioural change shares some common characteristics with other behavioural tasks, it also differs in important aspects like the values and probabilities of payoffs for each alternative or information presence. Hence it can be assumed the current task is novel in its design.

The present study introduces the concept of persistence with behavioural change as a tendency to maintain a novel behaviour without returning back to a habitual behaviour despite the initial lack of rewards. Persistence with behavioural change is required through this frustrating phase until the novel behaviour consolidates and starts bringing the benefits which were the change motivators in the first place. We argue that this process may be inherent not only to health behaviour change, and introduce a paradigm of persistence with behavioural change to measure it. The paradigm involves a series of choices between habitual and novel key-to-response mapping in order to complete paths displayed on a computer. Opting for the habitual mode leads to small, predictable

outcomes, whereas the novel behaviour includes larger outcomes that can be gained only by a degree of persistence through the initial, frustrating period. In the following, experimental section, the paradigm is introduced in detail and how it maps onto real-world behavioural change is explained. A simple manipulation of the habitual option values is applied to present a possible way of using the paradigm. Specifically, two conditions are introduced: default payment condition and low payment condition. In the low payment condition, the value of the habitual option is diminished. This could simulate, for instance, the use of drug disulfiram inducing sickness in an ex-alcoholic should she return to drinking, which counteracts the attractiveness of returning to the habitual option (e.g. Azrin, Sisson, Meyers, & Godley, 1982; Irvin, Bowers, Dunn, & Wang, 1999). Thus the focus here is placed on both the effectiveness of the paradigm in measuring persistence with behavioural change as well as the paradigm applications.

# Method

## *Participants*

In the study, 126 Warwick university students (65% women, mean age = 21) were recruited via SONA, an online recruitment system. Half of the participants were assigned to the default payment condition and half to the low payment condition. The study was approved by the University of Warwick Humanities & Social Sciences Research Ethics Committee (HSSREC).

## *Paradigm of persistence with behavioural change*

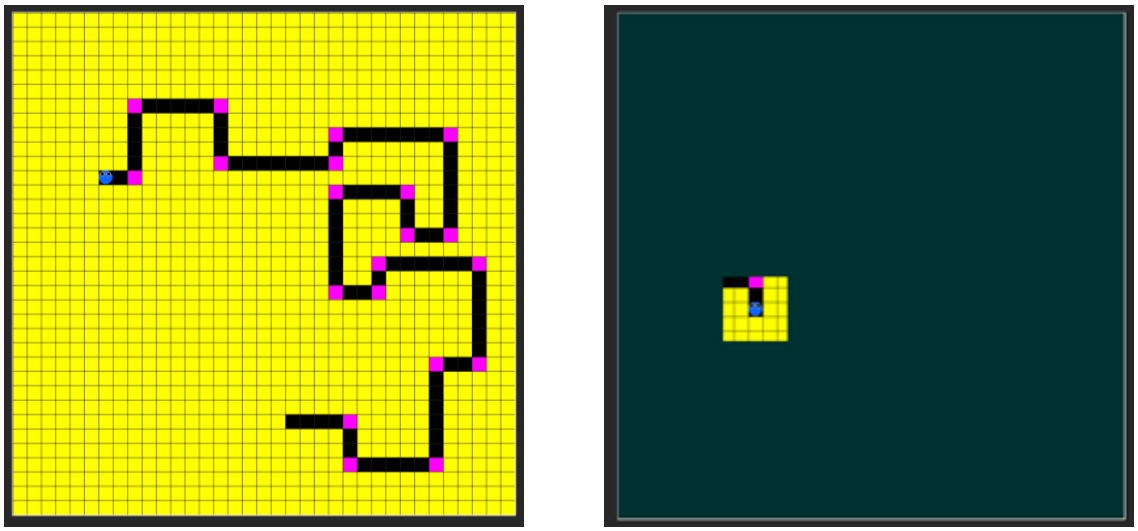
### Basic layout

In the following section, the default version of the paradigm of persistence with behavioural change will be described in detail. For the correspondence of the individual paradigm features to real world behavioural change, refer to Table 1.

The key visual feature of the paradigm was a path which was programmed in BlitzMax and displayed on a computer screen as a 35 x 35 field matrix (see Figure 1a). In total, 56 paths were designed in Excel. All the paths had the same quantitative properties: each was 102 fields long and consisted of 20 turns. The turn fields were displayed in a different colour than the remainder of the path and every possible direction of the turn

(up, down, left, and right) was represented five times in each path. The number of fields preceding the turns was also constant across all the paths: 2 fields appeared 2x, 3 fields 5x, 4 fields 2x, 5 fields 2x, 6 fields 2x, 7 fields 5x, 8 fields 2x. However the paths were qualitatively distinct from one another in order to appear different to the participants, i.e. the starting and ending position varied within the matrix, and the sequence of the turn directions and the number of fields preceding each turn was not constant.

The aim of the task was to move an avatar from the beginning to the end of the path using a keyboard. Movement from one field to another required one key press. The program recorded whether the correct key change was performed at each turn field. Only the immediate context of the path was immediately visible at a time, i.e. the participants could not see the whole path, hence were unable to predict the coming turns in advance (see Figure 1b). Each path corresponded to one trial and had to be completed within a target time in order to prevent overt deliberation on the key selection. The target time, set to 27 seconds, was determined from Pilot 1 (see Box 1). The path could be completed either with a habitual or novel key-to-response mapping.



a) b)

Figure 1. The visual display of the main task depicting a) the complete path and b) immediate context only as it appeared to participants.

Note. The avatar (displayed as a blue, filled-in circle) has to be moved with keyboard keys from the start to the end of the path (black fields). The purple fields signify the fields on which a key change needs to be made. Yellow fields represent a wall. The area visible to a participant in Figure 1b is the 5 x 5 field window centred around the avatar.

*Box 1. Pilot 1*

*Aim:* to find the length of time most people take to complete a path with the habitual key to response mapping

*Method:* 14 participants were invited to complete 10 paths with the habitual key to response mapping. The participants were instructed to do so as quickly as possible. Half of them were given a 25 second time limit for each path and the remainder completed the paths with a target time of 30 seconds.

*Results:* 12 participants took part in the pilot study: 7 completed the path with the 25-second time limit. The group with the 30-second time limit completed on average more paths in time (i.e. 9.8) than the group with the stricter target time (i.e. 6.7). Hence the completion times from the former group were further analysed: the average time was 24 seconds with a standard deviation of 1.4. The length of time it takes most people to complete a path was calculated from the mean plus two standard deviations (i.e. 26.8 seconds).

*Conclusion:* The target time for each path was set at 27 seconds.

## The habitual versus new behaviour choice options

Each path could be completed with the habitual or a new key to response mapping. The habitual mode, called the blue mode, involved moving the blue avatar and playing for blue coins with the standard use of the arrow keys, i.e. the → keypress moved the avatar to the right, the ← keypress to the left, the ↑ keypress up, and the ↓ keypress down. In the new mode, called the red mode, the participants moved the red avatar and could earn red coins. The key to response mapping was novel: whilst the ↑ and ↓ keypresses led to the same movement as in the blue mode, the → keypress now meant left, the ← keypress right. In both modes, the program recorded whether the correct key change was made at each turn field. In the blue mode, the participants received one blue coin for each correct turn. Once a blue coin was earned, it could not be lost. Up to 20 blue coins could be earned per trial. Blue coins appeared on the right side of the screen as they were earned in a trial. In the red mode, the participants could earn one red coin per trial if they completed all the turns correctly within the time limit. Hence if they made a mistake at any purple turn or did not complete the path in time, they would lose the

chance to earn the red coin on that particular trial. During each trial, those who selected the red mode had an option to switch back to the blue mode by pressing the control key. If the key was pressed, the red avatar turned to the blue avatar and the participants could complete the trial using the habitual key to response mapping (and earn blue coins). If participants opted to switch back from red to blue, there was no option to switch back to red during the trial.

## The values of the blue and red coins

The payment value of the blue coin was set to 0.5 pence so people could earn up to 10p per trial (0.5p times 20 turns). The blue mode outcome was deliberately small, although its exact value was set arbitrarily. The red coin value was 25 pence. This was determined from Pilot 2 with the condition that the new mapping should bring higher earnings in total to most people despite inevitable failures (see Box 2). The crucial difference was between the timing of the blue and red coin rewards. Whilst the blue coin was given for each correct turn in the blue mode, the red coin was rewarded only for completing the trial within the time limit without making a mistake on any of the 20 turns (refer to Table 1 for a detailed explanation of this difference).

When a participant made a mistake, the best course of action was to stay with the red mode to practice the new key-to-response mapping. However, as mentioned above, there was an option to switch back to the blue mode before completing this trial. This represented relapse (for further explanation, refer to Table 1). The option of going back to the red mode was disabled for the rest of the trial and could be selected again only before the start of the next trial. Had the option been enabled, it would have captured lapse, i.e. going back to the habitual behaviour but not staying with it (Larimer et al., 1999). This would be an interesting feature of the paradigm that could certainly be added in future. However for the default version of the paradigm, we decided not to include the option of lapses for several reasons. Firstly, as the time limit of each trial was short, it is likely participants who lapsed would not manage to complete it on time, hence would not earn the red coin anyway. Secondly, if the red coin was received despite a lapse, the conditions leading to its earning would have been different to the conditions without the lapse. In other words, those who would earn the red coin with lapses would not have learnt the new key-to-response mapping to the same level as those who completed the path without making a mistake. Given the two technical complications as well as previous findings suggesting that most lapses lead to relapse

(e.g. Brandon, Tiffany, Obremski, & Baker, 1990), we have decided not to include this option in the default versions of the paradigm.

## *Design*

The study employed a between participant design with two conditions varying the value of the blue coin: default and low payment. The default payment condition represented the standard paradigm values for blue and red coins, which are specified above. In the low payment condition, the value of the red coin remained the same as in the default condition but the value of the blue coin was reduced to 0.05 pence in order to counteract the attractiveness of the habitual key-to-response mapping by making its earnings extremely low.

*Box 2. Pilot 2*

*Aim 1*: to determine the value of the red coin, so that switching to the new key to response mapping brings higher total earnings for most participants than staying with the habitual mapping

*Aim 2*: to find evidence that the switch is beneficial for most participants

*Method*: 11 participants completed the whole paradigm task with a forced switch setting. Specifically, after the practice trials with the habitual mapping, they had to complete 51 trials with the new mapping, hence no choice between the blue and red mode before or during the trial was provided.

*Results:* The learning curve was the steepest in the first third of the trials. For the remainder of the task, the majority of participants (i.e. 7) succeeded on more than half trials. The value of the red coin was set to 25p per path, so all of these participants would earn more in total with the novel mapping than with the habitual mapping (i.e. £7 on average in the red mode compared to the maximum of £5.10 in the blue mode).

*Conclusion*: The pilot determined what the value of the red coin should be and showed that the majority of people can benefit from the switch if they persist in trying to succeed.

## *Procedure*

The experiment was run in a large open laboratory with multiple computers, each in a private screened cubicle. After reading general instructions about the study, including ethics rights and experiment structure, the paradigm task appeared on participants' computer screens.

Three sets of detailed instructions were displayed at specific points during the task (see Appendix A for the actual transcripts). The first set of instructions was presented at the beginning, familiarising the participants with the basic task setting, including the instructions of how to move the avatar and the meaning of each field. These instructions were followed by one practice trial. The purpose of the trial was to move the avatar from the beginning of the path to the end with the habitual key to response mapping. There was no time limit and no coins were earned at this point. After this trial, the participants were presented with the second set of instructions, explaining how to earn

blue coins and what the target time is. Then they completed four timed practice trials with a habitual key to response mapping whilst playing for blue coins. After the practice trials, the third set of instructions appeared, explaining the possibility to play for red coins and comparing this mode to the blue mode. The option to switch from the red to the blue mode was also described. Importantly, the participants were told the following: "On the whole, people tend to earn more in total if they persist in learning to use the red avatar; but this may not be true for everyone. Of course, you should choose whatever you feel is likely to work best for you." The reason for its disclosure was to ensure the real world correspondence (see Table 1).

After reading the third set of instructions, the participants were given three control questions testing their understanding of the instructions (see Appendix B for the actual transcript of the control questions). Specifically, the first question was focused on the difference between playing for blue versus red coins. The second question asked about the value of the blue and red coins. The final question was aimed at understanding the switch from the novel to habitual mode during the trial. If the participants answered any of the questions incorrectly, they were prompted to re-read the instructions. The participants could proceed only once they answered all the questions correctly.

Then the participants were presented with 51 choice trials where they could decide between playing for blue or red coins. After the task was completed, they received an online questionnaire including demographic questions. After completing the questionnaire, the participants were paid based on their performance.

Table 1. The explanation of the paradigm features and their real world correspondence

| Paradigm features | Feature explanation and real world correspondence |
|---|---|
| Turns | In the habitual mode, each turn represents a rewarded instance of the habitual behaviour (e.g. craving satisfaction in smoking a cigarette). In the novel mode, the turn represents a possibility of choosing to stay with a new behaviour (e.g. not lighting a cigarette) or switch back to the habitual behaviour (e.g. lighting a cigarette). |
| Trials | Each trial stands for a unit of time during which a behaviour is repeatedly performed (e.g. one trial = one day during which a person smokes up to 20 cigarettes, each corresponding to one turn). |
| Blue coins | Rewards for the habitual key to response mapping, characterised by a small but regular and predictable value (e.g. smoking cigarettes gives a person an expected boost of nicotine, bringing desired but short lasting effects at regular points during the day). |
| Red coins | Rewards for mastering the new behaviour. Comparatively, the value of the red coin is much higher than the value of the blue coin (e.g. the value of being healthy due to not smoking is much higher than the value of feeling effects of a cigarette for those who wish to stop smoking). |
| Timing of rewards | Blue coins are earned easily (due to their habitual nature) and at predictable times (every turn). Conversely, red coins are earned at the end of the trial only if all the turns are performed correctly and within the time limit. There are two reasons for the timing differences between blue and red coins. Firstly, completing the red mode without a mistake and within the time limit ensures the novel mapping was learnt to comparable standards with the habitual mode. Secondly, the red coin reward timing makes the task harder and less predictable, so it can correspond better to real world behavioural change. For example, refusing to smoke one cigarette is unlikely to improve health dramatically. It is only after a certain amount of time one starts feeling better. However it is unclear when that will occur. |

Table 1 continued

| Paradigm features | Feature explanation and real world correspondence |
|---|---|
| Choice before each trial | Before each trial, participants can choose whether to play for blue or red. There is no time restriction for this choice. This is supposed to represent a 'cold' state whereby one plans to behave in a certain way without feeling the consequences of the decision directly at that moment. For example, one may plan to stop smoking the next day before going to bed. |
| Switching from red to blue during the trial | In contrast to the previous choice, switching from red to blue whilst completing the path represents a 'hot' state whereby one decides to complete the trial in the blue mode due to failing on one of the turns in the red mode. This decision is likely to be fuelled by a momentary feeling of frustration and is supposed to represent a relapse. For example, whilst feeling withdrawal symptoms during the first day of not smoking (completing a path in the red mode before mastering the new mapping), one may decide to light a cigarette (switching from red to blue during the trial) and continue to smoke for the rest of the day (completing the path in blue) with an aim to stop smoking the next day (choosing red in the cold state). |
| Information provided to participants in the third set of instructions | Before starting the choice trials (51 trials of deciding whether to play for blue or red), participants are told the following: "On the whole, people tend to earn more in total if they persist in learning to use the red avatar; but this may not be true for everyone. Of course, you should choose whatever you feel is likely to work best for you." This information is based on the actual findings (from Pilot 2) and is given to participants in order for them to understand that learning the new mapping is possible for most people, and if one persists the total earnings will be higher. Similarly, people who are thinking about stopping smoking understand that not smoking brings higher rewards in the long term compared to smoking. They also know many people managed to stop smoking in the past. |

# Results

## *General characteristics of data*

Four participants from the low payment condition were excluded: two participants had to terminate their task due to technical issues with the program and/or equipment (e.g. a broken keyboard) and two participants were excluded[4] as they struggled to learn the habitual key-to-response mapping. After the exclusion, 122 participants in total were included in the further analysis (63 in the default payment and 59 in the low payment conditions).

Three dependent variables in the paradigm were assessed. The first variable - new choice – was calculated as a total number of red trials the participants opted for at the beginning of each trial. The new choice represented the willingness to change. The second variable – persistence with behavioural change – considered only the trials on which people selected the new mapping and did not switch to the habitual mapping during completion of the path. The persistence with behavioural change variable signified the extent to which people persisted in the new mode. The third variable – red coins earned – was calculated as the total number of red coins earned across all the trials, representing success with the switch. The values of all the variables ranged from 0 to 51.

The variables were not normally distributed as a great proportion of the data was concentrated in the tails of the distribution, i.e. mostly habitual or new behaviour choices were often selected. As the data contained many ties (i.e. high number of the pure habitual and novel behaviour strategies), non-parametric tests based on ranking, e.g. the Mann-Whitney U test, were not suitable for the inferential analysis (Howell, 2007). Therefore, the generalized linear mixed model, a model based on logistic regression, was applied (Nelder & Wedderburn, 1972).

[4] The exclusion on the basis of poor performance was determined by checking the participants' performance in the four timed practice trials with the habitual to response mapping. The full score from these trials was 80 blue coins. The cut-off point was set to 48 coins, i.e. those who earned less than 48 blue coins in total were excluded. The cut-off point was derived by allowing one trial not to lead to earnings (this would be usually the first trial where people might have produced too many presses leading to unnecessary errors or have questions to the experimenter) and for the other three trials, having 20% of turns incorrect. In practice, most people scored close to 80 coins.

## *Choice strategies*

Four groups of choice strategies were identified for the new choice and persistence with behavioural change variables, where the former was based on the extent to which every participant switched to the new behaviour and the latter on persistence with this switch. Specifically, the number of trials on which every participant switched or persisted were converted into proportions. For instance, when the novel mapping was selected on 10 out of 51 trials but only on 2 trials the path was completed in this mode, the proportion of new choice was 0.20 (= 10/51) and the proportion of persistence with behavioural change was 0.04 (= 2/51) for this particular participant. Each individual proportion was then assigned to one of the four groups, depending on its size. The first group included proportion ranging from 0 to 0.25 and indicated a low rate of switch or persistence. The second and third group ranged from 0.25 to 0.5 and 0.5 to 0.75 respectively, and suggested prevalent use of mixed strategies. The last group, with proportions from 0.75 to 1, characterised high preference for switch and persistence.

Figure 2 depicts the participant representation in each group for both the variables in the default condition. The function of this figure is to provide a comparison of the use of the strategies when cases of relapse are considered (the persistence with behavioural change variable) and when they are not (new choice variable). Regarding the new choice variable, a slight majority of the participants opted for the new choice, whilst the habitual option was selected by around one third of the participants. However many of those who selected the new mapping switched back to the habitual mode during the trial as the graph for the persistence with behavioural change variable shows. Hence for the persistence with behavioural change variable, mixed strategies were used more commonly than in case of the new choice variable. Consequently, the novel option without relapsing was chosen by less than a third of the participants, leaving the habitual mapping the most popular alternative.

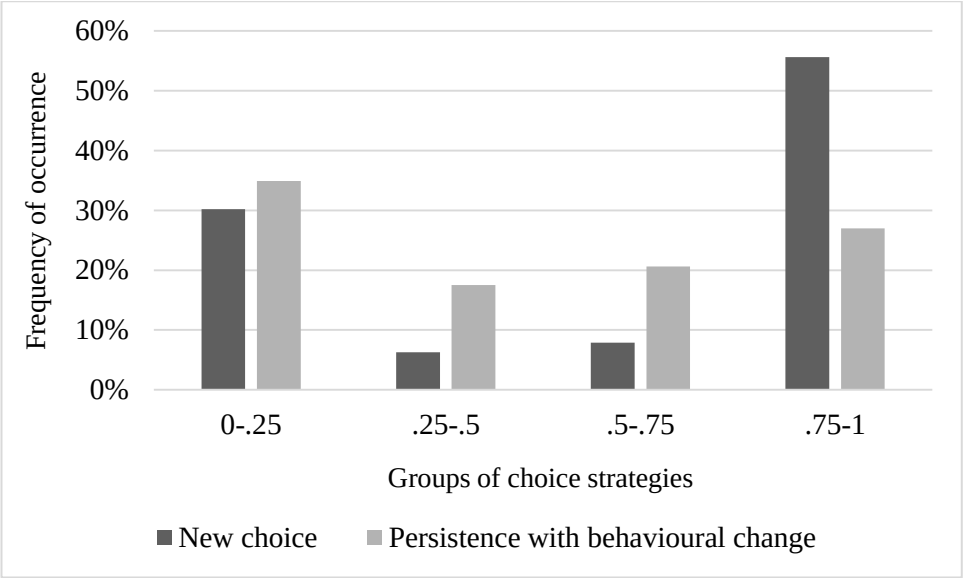



Figure 2. The occurrence of the different groups of choice strategies based on the proportion of switches to new behaviour and persistence with it across all the trials for each participant (the default condition only).

Note. The proportions were calculated for each participant out of all the 51 trials. A greater proportion group indicates a higher number of selecting the novel mode regardless of the subsequent relapse (new choice variable) and a higher number of trials completed in the novel mode without relapsing (persistence with behavioural change variable). Specifically, the 0-.25 group points to a low rate of the novel mode switches and persistence with them, whereas the .75–1 category signifies a high number of the novel mode switches and persistence with them. The remaining two categories indicate the employment of mixed strategies.

## *Default payment vs. Low payment*

The central values and standard deviations for the main variables split by each condition are listed in Table 2. On average, the red mode was chosen in more than half of the trials in both groups, although this choice was more frequent in the low payment condition. In both conditions, the number of trials on which people persisted was not the same but lower than the amount of the new mapping choices before each path completion. The persistence with behavioural change was more pronounced in the low payment group. This group also earned more red coins on average than the default payment condition. Although the central values provided some indication of the results, they were not sufficiently informative due to great standard deviations displayed in both groups for all the variables.

Table 2. Descriptive statistics of the main experimental variables split by each condition.

| Condition | Variable | | |
|---|---|---|---|
| | New choice | Persistence with behavioural change | Red coins earned |
| Default payment | | | |
| Mean | 32.0 | 24.2 | 17.5 |
| Median | 44.0 | 23.0 | 19.0 |
| SD | 21.0 | 18.4 | 15.2 |
| Low payment | | | |
| Mean | 38.8 | 31.5 | 22.2 |
| Median | 48.0 | 34.0 | 27.0 |
| SD | 17.0 | 16.3 | 14.3 |

Note. The range of the variables is 0 to 51 where 51 is the total number of trials and indicates that on all the 51 trials people switched to the new behaviour, persisted with it and earned the red coin. In other words higher values point towards greater willingness to change, persistence with the change and success on the changed behaviour.

Figure 3 presents individual differences in the strategies used between the two conditions for the persistence with behavioural change variable. In the low payment condition, more participants displayed high persistence with behavioural change, whereas preference for the habitual option decreased. Mixed strategies were comparable to the default condition.

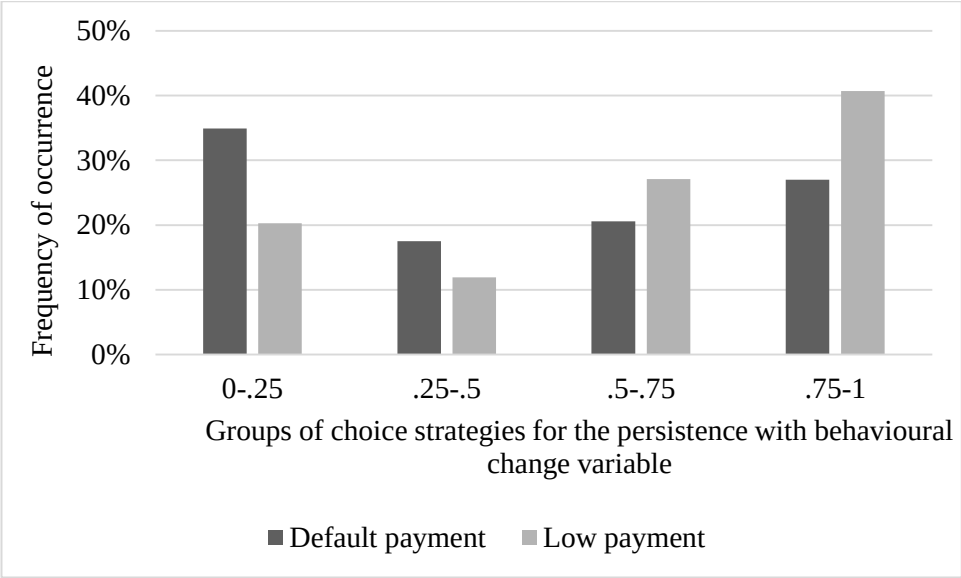



Figure 3. The default versus low payment condition comparison of the occurrence of the different groups of choice strategies based on the proportion of persistence with new behaviour across all the trials for each participant.

Note. The proportions were calculated for each participant out of all the 51 trials. A greater proportion group indicates a higher number of trials completed in the novel mode without relapsing (persistence with behavioural change variable). Specifically, the 0-.25 group points to a low rate of persistence with the novel mode, whereas the .75–1 category signifies a high persistence with the novel mode. The remaining two categories indicate the employment of mixed strategies. The default payment condition differs from the low payment condition in the value of blue coin that is considerable lower in the latter condition.

The generalized linear mixed model was applied to assess the differences between the conditions further. The test showed significant differences between the conditions for the new choice ($z = -2.14$, $p = .032$, CI[-3.30,-0.13]), persistence with behavioural change ($z = -2.30$, $p = .022$, CI[-2.21,-0.16]), and red coins earned ($z = -2.06$, $p = .040$, CI[-1.83,-0.04]) variables.

# Discussion

Testing the paradigm of persistence with behavioural change showed high individual differences in the strategies applied. Regarding overall choices before each trial, the majority of people opted for either the novel or habitual option where the former was more popular. Thus pure strategies were preferred over mixed strategies. However, when measuring persistence with behavioural change, characterised by selecting the novel option at the beginning of each trial and not switching back to the habitual option

during the trial, the novel option was chosen less than the habitual option on the whole as many people switched back to the old mapping during the trials. Furthermore, making the value of the habitual mapping extremely low moved the preference towards the novel alternative, increased persistence with behavioural change and indicated greater success on the task in terms of the total number of red coins earned. For all these variables, the difference between the low and standard values of the habitual option was significant.

There are several reasons to suggest the current results of the laboratory paradigm of persistence with behavioural change may effectively simulate the initial process of the shift towards the novel option in real world settings. The case that a great proportion of the participants returned back to the habitual option, especially during the trial, could imply that the process of persisting with the novel alternative presents a great struggle for people. Moreover, the analysis revealed high individual differences in the strategies applied during the change, which shares common ground with real life examples. For instance, in the paradigm, some participants barely tried the novel mapping. Similarly, some smokers do not stop smoking, although they know this habit can be detrimental, and not smoking may lead to greater benefits. On the other hand, there are people who stop smoking easily. In the paradigm, some participants consistently chose the novel option and did not return back to the habitual alternative despite the immediate absence of gains. Using a mixed strategy was also common. Many changes were performed from the novel to the habitual mode during the trial. This could be compared to relapse in a real life setting, a common occurrence during behavioural change (e.g. Larimer et al., 1999), whereby people stop smoking for some time but go back to this habitual behaviour. Hence the case that the paradigm task is frustrating enough to produce high individual differences in strategies used, some of which lead to relapse, provides basic evidence that the paradigm of persistence with behavioural change simulates the real life struggle during transition from a habitual to a new behaviour.

Regarding the manipulation in this experiment, lowering the value of the habitual option moved people's preferences towards the novel alternative. Similarly, in the real world, making alcohol drinking less attractive through the adverse effects of taking disulfiram, helps to decrease engagement with the habitual behaviour (e.g. Azrin et al., 1982; Irvin et al., 1999). Interestingly, there were participants who consistently stayed with the habitual option even when the value of the habitual mode was set at a lower level, bearing barely any total rewards. It is possible the value of the habitual option was not

adverse enough as it is the case with the effects of disulfiram. Perhaps if people made a loss for every blue coin, they would have persisted with the new option even to a greater degree. Nevertheless, making the value of the habitual option very low is one possible application of the paradigm with behavioural change.

To summarise, the paradigm of persistence with behavioural change presents a plausible simulation of the corresponding phenomenon in a real world setting. It captures the struggle through the initial, frustrating period of change that requires persistence with a novel behaviour. The paradigm also displays individual variations in approaches to change, including cases of relapse. Showing that diminishment of the value of the habitual option leads to similar results as in real life provides further evidence for the paradigm effectiveness, and presents one of its applications.

## *Applications of the paradigm of persistence with behavioural change*

The following section lists four general ways in which the paradigm could be used. The first approach focuses on changing the values of the coins or the frequency with which they are rewarded. The second approach is based on using the information about the optimal strategy for the paradigm. The third approach is to test the effects of further variables. The final approach narrows the research investigation by focusing on a sub-sample of participants or section of the paradigm.

### Changing value and frequency of rewards

The value and presence of a reward readily influences people's behaviour (Skinner, 1953). Hence trying to alter the paradigm values and their frequency might enhance understanding of behavioural change. A number of alternations can be done. Firstly, the value of the habitual option could decrease the more it is selected as it was done in the melioration experiments (Tunney & Shanks, 2002). This would represent the process of habituation whereby the effect of an option decreases the more it is attended to (e.g. Thompson & Spencer, 1966). Secondly, the frequency with which the value is rewarded could also be modified. For instance, a negative value for the blue coin could be administered at certain turns, causing an irregular schedule of gains. This could simulate situations in which engaging in a habit can bring negative effects once in a while like having bad cough or chest pain whilst smoking, which should decrease the attractiveness of this option. Thirdly, the investigation could be based on arranging

rewards in the red mode to make persisting more motivating. For example, introducing little rewards at each correct turn in the red mode may increase persistence with the frustrating task: a smoker could put aside a small amount of money towards something he desires every time he would have smoked but instead chose not to.

## Changing the information about the optimal strategy

In the default version of the paradigm, the participants receive information that the majority of people in a previous study earned more overall when they persisted with the novel mapping. Hence the optimal strategy is known to participants, simulating the situation when people are aware it is better to stop smoking. Past literature showed that information is an important factor in behavioural change (e.g. Fisher & Fisher, 1992). Hence in the paradigm, the information can be changed in various ways or omitted altogether to answer the following questions: To what extent is the presence of information about the optimal strategy relevant to actual behavioural change? If relevant, how sensitive are people to slight changes in this information? What is the best way to frame the information to motivate people? Are there individual differences in how people respond to information?

## Testing the effects of further variables

The extent to which further variables influence the paradigm can be measured by adding a manipulation either before the start of all the trials or in between each of them. Regarding the first option, we investigated the effect of mindfulness on the paradigm in another study by asking participants to listen to either a mindfulness or mind wandering recording (Sysalová, Chater, Watson, 2017). Similarly, researchers could test the influence of affect by manipulating its valence, for instance, via watching emotionally charged videos. The manipulation could also be positioned in between the trials. Feedback may be added after each trial that could test, for example, the effect of self-efficacy (Bandura & Adams, 1977) on persistence with behavioural change in a controlled experiment. Specifically, people in the self-efficacy condition could be given encouraging messages after failing at the novel option. Furthermore, peer effect could be tested by providing participants with the information about how other people are doing with the task.

## Focusing on a sub-sample of participants or the elements of the paradigm

Due to a varied use of strategies in the paradigm, it may be worth focusing only on one at a time and investigating it in greater depth. For instance, those who never wish to

change could take part in a study, which would test possible conditions under which these people may change their minds and try the novel behaviour. Alternatively, the investigation could be based on a section of the paradigm. For example, narrowing research to cold state choices only would be performed by making a choice at the start of but not during the trial. Disabling the possibility of relapse may improve persistence with behavioural change but it could also be counterproductive. Concretely, when the change becomes overwhelming, being able to relapse may give people courage to continue in trying to end a habitual behaviour.

To summarise this section, there are many varied uses of the paradigm of persistence with behavioural change. The values of the rewards and their frequencies can be adjusted to simulate different real life situations. The information about the optimal strategy can be altered or omitted to test its importance on behavioural change. The influence of further variables can be assessed by adding manipulations either before or during the trials. Finally, researchers may wish to work with a sub-sample of participants or disable certain features of the paradigm to give it a narrower focus.

## *Testing construct validity*

Construct validity assesses whether a test measures the actual construct (Cronbach & Meehl, 1955). The construct of persistence with behavioural change has been defined as staying with a novel behaviour without relapsing back to the habitual behaviour during the initial period of behavioural change. Persistence with behavioural change is measured by the paradigm, consisting of a number of features such as the blue coin earned for the habitual behaviour, the red coin received for the new behaviour, information provided to participants, and switching before and during each trial. Each of these features was explained and its real world correspondence suggested in Table 1. However before testing construct validity of the paradigm of persistence with behavioural change as a whole, each individual feature of this measure needs to be validated first. For instance, people who report to relapse frequently would be expected to display a high rate of switches back to the habitual behaviour during the trial.

In order to persist, people need to sustain their attention with the novel mapping and regulate their emotions when presented with repeated failure. Hence persistence with behavioural change should correlate in a positive direction with higher scores on standardised measures of sustained attention, e.g. the Continuous Performance Test

(Conners, 1994), and emotion regulation, e.g. the Negative Mood Regulation scale (Catanzaro & Mearns, 1990).

Moreover, the tasks similar to the paradigm could be applied. For instance, the amount of time people spend on persistence tasks like Mirror tracing (e.g. Matthews & Stoney, 1988) or the Anagram persistence task (e.g. Brandon et al., 2003) should be positively associated with a higher degree of persistence with behavioural change. Similarly, choosing from the decks with lower payoffs in the IOWA gambling task and having lower tendencies for melioration are expected to be linked to greater persistence with behavioural change.

Another way to measure construct validity is to compare groups which are expected to differ on a test (Cronbach & Meehl, 1955). For instance, smokers or gamblers who failed to change their habit in the past should score lower on the persistence with behavioural change variable, particularly due to a high degree of relapse.

Furthermore, construct validity could be assessed via the relationship between the paradigm and activation in the frontal cortex. It has been found that frontal cortex regions such as the orbitofrontal cortex and the anterior cingulate gyrus, which are involved in reward regulation and higher-order executive functions like self-control, show higher activation in addicts (e.g. Goldstein & Volkow, 2002; Yuan, Qin, Liu, & Tian, 2011). Thus it may be assumed such activation should also show in those who prefer to stay with the habitual option or keep on switching to it during the novel trials.

Lastly, in discussing the construct validity of the IOWA gambling task, Buelow and Suhr (2009) noted difficulties in assessing reliability, an aspect of validity, due to learning effects during the task. The same would apply to the paradigm as retaking it at a later time point would make the task less frustrating. One possible solution is to re-run the paradigm with a different key to response mapping, though the comparability of a new mapping to the established novel mapping would have to be checked.

To summarise, several ways of assessing the construct validity of the paradigm of persistence with behavioural change were suggested. Of course, this list is not exhaustive and there may be other suitable alternatives.

## *Paradigm limitations*

Like every measure, the paradigm of persistence with behavioural change has its limitations. Firstly, the paradigm is a simplified, laboratory simulation of real world

behavioural change. Although it is unlikely all the factors involved in this process were captured by the task, the aim was to focus on the key characteristics inherent in most behavioural change cases: differing values and reward frequencies of both options, the frustrating nature of the switch from the habitual to the novel behaviour, and the presence of information about the benefits of the change. Secondly, the time scale of making choices between the habitual and novel option in the paradigm is shorter compared to real world behavioural change where the former takes around 30-45 minutes and the latter weeks, maybe even months. This could affect the way people respond on the paradigm. For instance, they may find the switch easier as the rewards occur sooner, although in the current experiment, a sizeable group of participants stayed with the habitual option, which suggests there is comparability of the paradigm with real world behavioural change. Thirdly, although participants are not told how many choice trials they will have to do, they can estimate the end point of the experiment from being aware of the time at which the experimental session is supposed to finish, which could lead to an adjustment in their decisions. Conversely, in real life, such an end point is often not known. To make any of the end estimates more difficult, participants are told they will take part in two more tasks (a demographic questionnaire and individual payment) after the choice trial. Lastly, the rewards set in the paradigm are extrinsic, in the form of a payment. Although the real world outcomes of habitual and novel behaviour can also be extrinsic in nature (e.g. saving extra money by not smoking), they are often intrinsic (e.g. craving satisfaction or improved health). Being intrinsically motivated has been shown to be more effective in some contexts (Vansteenkiste, Lens, & Deci, 2006). Thus it is possible intrinsic rewards during real world behavioural change are stronger or perhaps qualitatively different.

## *Future research*

The first step for future research is to test for the validity of the paradigm in order to establish whether this task indeed assesses persistence with behavioural change. In the section above, several methods for measuring construct validity were described, including testing the group differences on the paradigm between addicts and non-addicts, comparing the paradigm results to other behavioural and cognitive tasks, and looking at correlations with neuroimaging evidence. Furthermore, the paradigm can be applied in a number of ways ranging from the change of payment values or frequencies, adjustment of information about the optimal strategy, to varying feedback or adding

manipulations. Lastly, the paradigm can be run alongside other measures of behavioural change like self-reports to provide complementary evidence.

# Conclusion

The current Study introduced the paradigm of persistence with behavioural change, a laboratory measure that captures the initial phase of a type of behavioural change when the outcomes of the behaviour to which one switches (novel behaviour) are not yet present and the outcomes of the original behaviour (habitual behaviour) are missing. Persistence with behavioural change involves maintaining focus on the novel behaviour without going back to the habitual behaviour. Only when people persist through this initial, frustrating phase, can they start receiving benefits for which they decided to change in the first place. The paradigm involves completing computerized paths with either a habitual or a novel key-to-response mapping. People also have a choice to switch back to the habitual behaviour whilst completing the path. High individual differences in the strategies applied were shown. Although people knew the switch is more advantageous, many of them decided to stay with the habitual behaviour or return to it after being unsuccessful with the novel behaviour. Moreover, the value of the habitual payment was greatly decreased compared to the default value. This manipulation increased people's persistence and demonstrated how the paradigm could be applied. Further applications were discussed as well as the next steps for assessing the construct validity of the paradigm. Lastly, the paradigm limitations and future research suggestions were presented. To summarise, the paradigm of persistence with behavioural change could act as a novel way of assessing this process, generating useful information and complementing current measures of behavioural change.

# Chapter 4

# The Influence of Immediate Context on the Trait Mindfulness Questionnaire (Study 2)

## Abstract

The study presents preliminary evidence that trait mindfulness questionnaires can be substantially influenced by immediate context, violating standard assumptions about the stability of such measures. We investigate the effect of mindfulness on a new measure of "persistence with behavioural change", namely a computerised paradigm of persistence with behavioural change (Sysalová, Chater, & Watson, 2018). Mindfulness was briefly induced in a laboratory environment and trait mindfulness scores were taken. The results of Experiment 1 unexpectedly revealed that persistence with behavioural change and trait mindfulness correlated positively for people assigned to the mindfulness condition and negatively for those participating in the mind wandering condition. Experiment 2 showed this pattern might have been due to immediate context, specifically the mindfulness induction and performance on the paradigm. Furthermore, the mindfulness induction led to a significantly higher persistence with behavioural change in Experiment 2, suggesting mindfulness can be beneficial in this domain. Yet the relationship was not found in Experiment 1. Reasons for these findings and suggestions for future work are discussed accordingly.

## Introduction

Mindfulness, a concept adopted from Buddhist traditions, has been receiving increasing attention in scientific circles in recent years. According to a psychological view, mindfulness can be understood as a state of present moment awareness achieved by regulating one's attention; this state is characterised by a set of attitudes like acceptance, openness, and curiosity (Bishop et al., 2004). Mindfulness can be realised by monitoring attention during day to day activities as well as by more formal practices like meditations focusing on breath, body or sound (Segal et al., 2012). Apart from the intrapersonal fluctuations of mindfulness over time, this concept is also believed to have

trait-like properties and vary amongst people (e.g. Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006). We shall consider both trait and state mindfulness in the study reported below.

One of the common ways to measure mindfulness is as part of mindfulness-based programs. The programs are usually run for 8 weeks and aim to develop a regular mindfulness meditation practice, helping people to cope with challenging aspects of life like stress, depression or pain management. Pre- and post- intervention data are collected and the difference informs researchers about the influence of mindfulness on a selected issue. One such program is the Mindfulness-based Relapse Prevention (MBRP) program, which aims to help people in avoiding relapse during behaviour change maintenance with the use of mindfulness practices (Bowen, Chawla, & Marlatt, 2011). The evidence that mindfulness affects behavioural change maintenance has been reported. For instance, participants who completed the program reported reduced alcohol drinking and substance use at one year follow-up compared to other programs (Bowen et al., 2014). Even shorter interventions were found to influence maintenance with behavioural change. Specifically, mindfulness led to reductions in smoking after the end of a four-week long intervention and 17 weeks later (Brewer et al., 2011). Significant results were also reported between trait mindfulness and reductions in smoking (e.g. Black, Sussman, Johnson, and Milam, 2012;), alcohol use (Black et al., 2011), and severity of dependence (Bowen & Enkema, 2014). Thus the previous findings suggest there is indeed a link between mindfulness and behavioural change maintenance.

In order to maintain novel behavioural patterns like not smoking or drinking alcohol, one has to persist through the initial, unpleasant phase when the outcomes of the new behaviour are not yet felt and the outcomes of the habitual behaviour are still desired. For instance, imagine a situation where one wishes to stop smoking. Smoking is a habitual behaviour which provides a person with regular and predictable positive outcomes, e.g. satisfaction of cravings. When the person stops smoking, these positive effects are no longer present and the outcomes of the new behaviour, e.g. feeling healthier, are also missing. In order for people to be successful at behavioural change, they have to persist through this phase, albeit that the experience of change is not very rewarding at first. In order to capture such a struggle, we designed an experimental paradigm of persistence with behavioural change (Sysalová, Chater, & Watson, 2018) in which people can choose between a habitual behaviour, bringing small but regular

rewards, and a novel behaviour, yielding large rewards which require time and learning to achieve. The paradigm enables us to measure the degree of persistence with behavioural change defined by switching to the novel behaviour and not relapsing back to the habitual behaviour. This degree of persistence can be further assessed in terms of how it is impacted on by various internal and external factors. The factor the present study focuses on is mindfulness.

Past literature offers several reasons why mindfulness might influence the responses in the persistence paradigm. Firstly, the findings about behavioural change maintenance and mindfulness, discussed previously, suggest persistence should be greater the more mindful people are. Secondly, success on the task may be influenced by sustained attention which was found to relate to mindfulness. MacLean et al. (2010) showed that a 3 month long meditation programme led to a better performance on a sustained attention task in a group of meditators compared to those who had not yet participated in the meditation programme (waiting list group). Examining the link with trait mindfulness, the "observe" component of mindfulness from the Kentucky Inventory of Mindfulness Skills (KIMS) has been linked to sustained attention measured by the Continuous Performance Test (Galla, Hale, Shrestha, Loo, & Smalley, 2012). Thirdly, the switch to the novel behaviour on the task inevitably brings the experience of failures. Such experience might be enhanced by emotion regulation which was found to positively correlate with trait mindfulness (e.g. Lyvers, Makin, Toms, Throberg, & Samios, 2014). It was argued that the reason why mindfulness improves emotion regulation could be due to enhanced executive control, specifically higher mindfulness might lead to greater sensitivity and responses to affective cues which may signal a greater need for control, aiding emotion regulation (Teper, Segal, & Inzlicht, 2013). Research also showed that participants tend to work longer on difficult tasks and thus tolerate distress better the higher they score on the facets of trait mindfulness (Evans, Baer, & Segerstrom, 2009; Feldman, Dunn, Stemke, Bell, & Greeson, 2014).

Persistence with behavioural change might be influenced not only by the attentional dimension of mindfulness but also its attitudinal orientation. For instance, being accepting about an ongoing frustrating situation, being patient or open to both success and failures might improve people's persistence on the task. Previous research showed that people with Type 2 diabetes were more likely to maintain their glucose levels within the recommended range after three months if they were assigned to the acceptance and commitment therapy group, consisting of learning acceptance skills,

compared to a standard educational group (Gregg, Callaghan, Hayes, & Glenn-Lawson, 2007). Hence the attitudinal dimension of mindfulness might also be important to enhance persistence with behavioural change.

On the whole, the previous studies suggest a link between mindfulness and persistence with behavioural change should be found. However the current study employs a different measure of behavioural change to the previous papers. Specifically, the behaviour is assessed in a controlled, laboratory setting, as opposed to obtaining self-reported data. It may be valuable to investigate whether the findings hold regardless of the measure applied. The aim of this study is therefore to assess how mindfulness affects persistence with behavioural change in a controlled laboratory setting.

In the present study, mindfulness is induced by telling one group to focus on the experience of the present moment by listening to a guided instruction recording, whereas the other, mind-wandering group is asked to elaborate about past memories and future expectations. Furthermore, mindfulness is assessed as a trait with Feldman, Hayes, Kumar, Greeson, and Laurenceau's (2007) Cognitive and Affective Mindfulness Scale-Revised (CAMS-R). The scale was selected for the following reasons. Firstly, the items encompass different components of mindfulness: present focus, awareness of experience, attentional regulation, and attitude of acceptance towards the experience. Secondly, the items lead to a single score. We considered the uni-dimensional character of the scale important as it may enable us to draw conclusions about the whole mindfulness construct in contrast with multi-dimensional scales, which allow only for inferences about individual components of the construct. Lastly, the items of the CAMS-R are framed as the self-reported ability or willingness to be mindful as opposed to the extent of the individual's mindfulness (Bergomi et al., 2013), where the former might be easier to understand. The trait questionnaire was positioned after the paradigm task as we wanted to make sure it does not strengthen the effect of the mindfulness condition due to the content similarity between the two mindfulness measures. It was initially assumed that the trait questionnaire itself would not be influenced by the induction or paradigm task as trait questionnaires measure stable characteristics of mindfulness (Bergomi et al., 2013), although this assumption is questioned in the light of our results below.

To summarise, the aim of the present study is to investigate the effect of mindfulness on persistence with behavioural change. Mindfulness is induced briefly and measured with

trait mindfulness questionnaire. Given the previous findings relating to behaviour maintenance, sustained attention, emotion regulation, and distress tolerance, the expectation is that a link between mindfulness and persistence with behavioural change would be found. However persistence with behavioural change is measured by a controlled laboratory experiment where repeated choices between a habitual and new option are made. Hence the study assesses whether the different measures result in similar findings.

# Experiment 1

## *Method*

### Participants

In the study, 77 university students or staff from the University of Warwick (55% women, mean age = 24) were recruited via SONA, an online recruitment system. The majority of participants (i.e. 63) did not regularly engage with contemplative practices such as meditation, yoga, or tai-chi. The remainder of participants cultivated at least one of the above practices.

### Material and measures

#### *Paradigm description*

Persistence with behavioural change is measured by the persistence paradigm. Participants are presented with a path, appearing on the screen in a 35 x 35 field matrix (Figure 1). The aim of the task is to move an avatar using a keyboard from the beginning to the end of the path. Participants complete 56 paths in total, each representing one trial. All the paths have the same quantitative but different qualitative properties. Each path has to be completed within a target time of 27 seconds in order to prevent deliberation on the key selection.

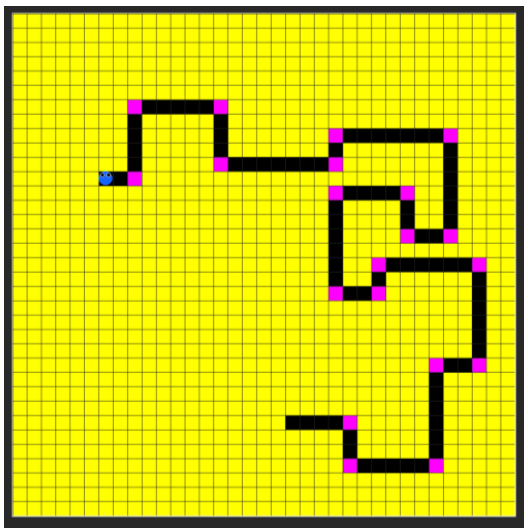
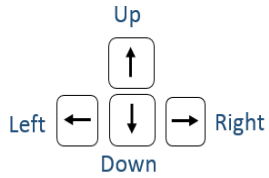
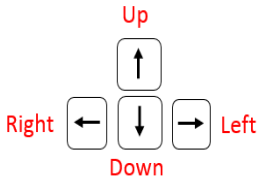


Figure 1. A visual display of the main task, depicting one of the paths.

Note. The avatar (displayed as a blue, filled-in circle) has to be moved with keyboard keys from the start to the end of the path (black fields). The purple fields signify the fields on which a key change needs to be made. Yellow fields represent a wall. In the actual experiment, the only visible area is a 5 x 5 matrix around the avatar.

Before each trial, the choice between completing a path with the habitual or new key to response mapping has to be made. The habitual mapping mode leads to regular but small rewards whereas the new mapping mode results in larger but less regular rewards which are difficult to achieve, especially at the beginning (see Table 1 for a more detailed comparison).

Table 1. Comparison between the habitual mapping mode (blue mode) and the new mapping mode (red mode)

| Mapping Mode | Key to response mapping | Reward properties | |
|---|---|---|---|
| | | Value | Condition |
| Habitual (blue) |  | 1 blue coin = 0.5 pence | One blue coin is earned if the correct key is pressed at each turn of the trial (20 turns per trial) |
| New (red) |  | 1 red coin = 25 pence | One red coin is earned if the correct key is pressed at all the turns of the trial (20 turns per trial) |

Whilst the blue mode is supposed to simulate the habitual attributes, which are predictable and regular, the red mode represents the uncertainty about the point at which the switch becomes beneficial. In other words, in order to start feeling the benefits of the new behaviour, participants have to master the task to a similar level as with the habitual keys. Although the outcome per trial is 2.5 times higher in the red mode, to reach it requires a degree of persistence. Crucially, the participants are informed that in a previous study most people earned more if they persisted in learning the new mapping. This information is based on pilot data and aims to ensure the participants know the switch is achievable and more effective. Hence as with any smoking cessation, people do not have to learn which strategy will be most beneficial from their own experience.

During each trial, those who select the red mode also have an option to switch back to the blue mode by pressing the Ctrl key. If the key is pressed, the red avatar turns into a blue avatar and participants can complete the trial using the habitual key to response mapping (and earn blue coins). This function represents the option to relapse at any point during the process of behavioural change.

### *The trait mindfulness questionnaire and demographics questions*

The trait mindfulness questionnaire and demographic questions were entered into Qualtrics, an online survey building software. The CAMS-R scale (in Appendix A) assesses trait mindfulness (Feldman et al., 2007). The questionnaire is standardised and

consists of 12 items, each with a four-point Likert scale (1 = Rarely/Not at all, 2 = Sometimes, 3 = Often, 4 = Almost always). The items contain the mindfulness components of attention ("I am easily distracted"), present focus ("I am able to focus on the present moment"), awareness ("I try to notice my thoughts without judging them"), and acceptance ("I am able to accept the thoughts and feelings I have").

Demographic questions like age, gender, field of study, regular practice of meditation, yoga, or tai-chi are included.

## Design

The study design consists of two conditions: mindfulness and mind wandering (see Appendix B for the full transcript). The inspiration for the mindfulness induction condition came from Watkins and Teasdale's (2001) study where mindfulness was induced by focusing on bodily sensations or external impressions, and the mind wandering condition was based on elaborate thinking. In this study, both conditions are administered as 14-minute long listening exercises. The length of this exercise was chosen as previous studies applying the same method most commonly selected 10 – 14 minute long inductions (Sysalova, 2018). The mindfulness condition comprises a guided body scan meditation recording from the mindfulness for the general public book by Williams and Penman (2011) and the mind wandering condition includes a recording that was developed for this study with questions prompting participants to think about the past or future. Specifically, in the mindfulness condition, people are asked to focus on their breath and then on the current sensations in individual body parts. The instructions are given in a gentle way with a reminder of self-acceptance should the attention stray away from the main focus.

In the mind wandering condition, people are asked to think of answers to a set of questions. The questions are about seven topics from daily life (e.g. visiting a restaurant, buying a gadget, or having a phone call). Each topic starts with instructions introducing the topic (e.g. "Topic number 7. Think of the last gadget you bought"). Then a 10-second long pause follows. After the pause, the participants are asked four questions regarding their past memories (e.g. "Where did you buy this gadget?") and four questions about their future expectations (e.g. "What is the next gadget you would like to buy?"). In between the questions, 8-second long pauses are inserted to enable participants to think about the answers. The mind wandering condition was recorded

with a voice similar to the one on the mindfulness meditation recording. The audio was edited in Audacity, an audio editing and recording software package.

### Procedure

The experiment was run in a laboratory with multiple computers, each separated by a barrier, so that participants could not see each other's screens. Up to 8 participants at a time took part in the study. The neighbouring seats to each participant were left empty to ensure more privacy. After reading general instructions about the study, including ethical rights, the structure of the experiment, and payment information, the paradigm task appeared on participants' computer screens. Firstly, the participants completed practice trials during which they familiarised themselves with the task layout and aim. The practice trials were performed in the habitual key to response mapping. After the practice trials, the participants read the instructions for the main, choice task. Subsequently, their understanding was tested by answering three test questions. The questions focused on differences in the value and schedule of payments between each behavioural alternative, and the method by which one can switch to the habitual option during the trial. If the participants answered any one of the questions incorrectly, they were prompted to re-read the instructions and try again. The participants could proceed once they answered all the questions correctly. Then the instructions for the listening exercise appeared. The participants were asked to take a particular sitting position, i.e. having their back straight, legs uncrossed, closed eyes or lowered gaze. Once everyone was ready, the participants were prompted to put the headphones on and listened to the recording. The listening exercise was followed by 51 choice trials where people made decisions between playing for blue or red coins. Then the participants filled in the online mindfulness questionnaire and demographic questions, and were paid based on their performance.

## *Results*

After the completion of the experiment, 6 participants had to be excluded for either inattentiveness (e.g. using their mobile phone during the experimental session) or having difficulty with the habitual task (i.e. participants were not used to pressing the standard arrow keys). Thus the analysed data were from 71 participants (mindfulness condition = 36, mind wandering condition = 35).

Three dependent variables from the main task were assessed: new choice, persistence with behavioural change, and red coins earned. The new choice variable was calculated

by the total number of the new mapping mode choices and represented the willingness to change. The persistence with behavioural change variable focused only on the cases when people opted for the new mapping mode before the trial and did not switch back to the habitual mapping mode during the trial. The variable signified the extent to which people persisted with the new behaviour. The red coins earned variable was calculated by summing all the trials on which a participant earned the red coin and represented success with the switch. All the three paradigm variables were not normally distributed. The value range of the variables was from 0 to 51 where the larger number indicated the higher number of trials on which people were willing to change, persisted and succeeded on the task. Additionally, the trait mindfulness score was calculated: the values of three items were reversed and then added to the sum of the remaining item values. The total mindfulness score ranged from 12 to 48, where the higher value indicated greater trait mindfulness.

## Mindfulness induction results

The central values and standard deviations of the main variables for the both conditions are depicted in Table 2. The differences between the conditions seemed to be very small for all the variables. Indeed, the generalized linear mixed model was applied to assess the differences between the conditions further. The test showed no significant differences between the conditions for the new choice ($z = 0.51$, $p = .611$, CI[-1.99, 3.63]), persistence with behavioural change ($z = 0.62$, $p = .536$, CI[-1.02, 1.97]), and red coins earned ($z = 0.05$, $p = .962$, CI[-1.35, 1,43]) variables.

Table 2. Descriptive statistics for the experimental variables split by condition

| Condition | | New choice | Persistence with behavioural change | Red coins earned |
|---|---|---|---|---|
| Mindfulness | Mean | 34 | 27 | 21 |
| | Median | 46 | 34 | 22 |
| | SD | 20 | 18 | 17 |
| Mind wandering | Mean | 34 | 28 | 20 |
| | Median | 47 | 30 | 19 |
| | SD | 20 | 19 | 17 |

Note. The range of the variables is 0 to 51 where 51 is the total number of trials and indicates that on all the 51 trials people switched to the new behaviour, persisted with it and earned the red coin. In other words higher values point towards greater willingness to change, persistence with the change and success on the changed behaviour.

## Trait mindfulness results

Cronbach's Alpha for the CAMS-R scores was .71. Kendall Tau test, the non-parametric correlational test, was applied to assess the associations between the CAMS-R scores and main variables. Similarly to the manipulation results, no relationship was found for new choice (rt = -0.04, p = .337), persistence with behavioural change (rt = 0.01, p = .488), and red coins earned (rt = -0.01, p = .462). However an unexpected pattern was detected for the CAMS-R scores and main variables when split by the conditions. Specifically, in the mindfulness condition, the correlational coefficients between the CAMS-R scores and main variables were in a positive, significant direction whereas in the mind wandering condition, the direction was negative (see Table 3).

Table 3. Kendall correlational coefficients between dispositional mindfulness and experimental variables split by the conditions (Experiment 1)

| | Condition | |
|---|---|---|
| Variables | Mindfulness | Mind-wandering |
| New choice | .23* | -.36** |
| Persistence with behavioural change | .23* | -.24* |
| Red coins earned | .23* | -.27* |

Note. The questionnaire measuring dispositional mindfulness (CAMS-R) was positioned after the mindfulness induction and the paradigm task. ** $p < .01$, * $p < .05$.

## *Discussion*

Experiment 1 produced some unexpected results. Although trait mindfulness scores did not correlate with the paradigm variables overall, when each induction condition was considered separately, significant associations were detected. Interestingly, the direction of the correlations was positive in the mindfulness condition and negative in the mind wandering condition.

Two interpretations of the results seem natural. The first interpretation is that the induction conditions influenced people in a different way depending on their level of trait mindfulness. Specifically, the mind wandering induction was beneficial in terms of willingness to change, its persistence and overall success the lower trait mindfulness people reported. Conversely, the mindfulness induction was counterproductive to behavioural change the lower people scored on the trait measure. This could possibly be due to people being presented and influenced by the state which they are not normally accustomed to, i.e. those who are new to mindfulness might not find meditating rewarding at first, as the immediate rewards of such practice are missing unlike other activities they are normally engaged with (Brewer, Davis, & Goldstein, 2013).

The second interpretation of the results is that trait mindfulness scales are influenced by immediate context: induction experience and their performance on the persistence task. Specifically, those who experienced the mindfulness condition could report that their trait mindfulness is higher the better they performed on the task, whereas those who were assigned to the mind wandering condition could attribute their success to deliberation and hence rate their levels of mindfulness lower. This would be in conflict

with the assumption that trait mindfulness scales measure stable characteristics of mindfulness (e.g. Bergomi et al., 2013).

To determine which of the two interpretations is more plausible, the position of the trait mindfulness scale is changed in the following experiment. Placing the scale before the induction and paradigm task enables result comparison with the findings from the previous experiment where the questionnaire came after all the tasks. If the relationship between the trait mindfulness scores, mindfulness induction and paradigm variables remains similar, then it could be concluded that the mindfulness and mind wandering inductions may influence participants differently depending on their dispositional mindfulness as the first interpretation suggests. If the association found is no longer present, it could be argued the results of Experiment 1 may be due to immediate context, hence the second interpretation would apply.

# Experiment 2

## *Method*

### Participants

59 participants took part in Experiment 2. The participants were the University of Warwick students (63% female; mean age = 21) recruited via the SONA system. Most participants (i.e. 52) did not regularly practice meditation, yoga, or tai-chi.

### Design

Experiment 2 was identical to Experiment 1 with one crucial difference: the CAMS-R scale was positioned before the paradigm task and mindfulness induction.

### Procedure

Firstly, the general instructions were read. Then the participants completed the CAMS-R scale. This was followed by the first part of the paradigm task, containing the practice trials and instructions for the choice trials. After the first part of the paradigm task, the participants listened to one of the two audio recordings, depending on the condition to which they were assigned. Once the listening part was finished, the participants completed the 51 choice trials. At the end, they were instructed to fill in the

demographic questionnaire and were paid depending on the number of blue and red coins earned.

## *Results*

Two participants were excluded due to technical issues on their computers. Hence the data from 57 participants were analysed (mindfulness condition = 27, mind wandering condition = 30). Cronbach's Alpha for the CAMS-R scores was .74.

The positive and negative correlations found in Experiment 1 were no longer present. Table 4 presents the correlational coefficients between the paradigm variables and trait mindfulness for each condition separately.

Table 4. Kendall correlational coefficients between dispositional mindfulness and experimental variables split by the conditions (Experiment 2)

| | Condition | |
|---|---|---|
| Variables | Mindfulness | Mind-wandering |
| New choice | -.03 | -.08 |
| Persistence with behavioural change | -.02 | -.10 |
| Red coins earned | -.08 | -.14 |

Note. The questionnaire measuring dispositional mindfulness (CAMS-R) was positioned before the mindfulness induction and the paradigm task.

Regarding the overall effect of the mindfulness induction on the paradigm variables, people scored consistently higher on the paradigm task in the mindfulness compared to the mind-wandering condition (see Table 5). Further analysis revealed these differences were significant: new choice ($z = -2.30$, $p = .021$, CI[-5.79, -0.48]), persistence with behavioural change ($z = -2.61$, $p = .010$, CI[-3.12, -0.42]), and red coins earned ($z = -2.66$, $p = .010$, CI[-2.86, -0.40]).

Table 5. Descriptive statistics for the experimental variables split by condition in Experiment 2

| Condition | | New choice | Persistence with behavioural change | Red coins earned |
|---|---|---|---|---|
| Mindfulness | Mean | 42 | 34 | 28 |
| | Median | 51 | 39 | 35 |
| | SD | 16 | 17 | 16 |
| Mind wandering | Mean | 33 | 23 | 16 |
| | Median | 41 | 26 | 18 |
| | SD | 21 | 16 | 15 |

Note. The range of the variables is 0 to 51 where the latter corresponds to the total number of trials and indicates that on all the 51 trials people switched to the new behaviour, persisted with it and earned the red coin. In other words higher values point towards greater willingness to change, persistence with the change and success on the changed behaviour.

# General Discussion

Assessing the effect of mindfulness on persistence with behavioural change generated some unexpected results regarding the trait mindfulness measure. Namely, correlations between the paradigm variables and trait mindfulness questionnaire scores were in a positive direction when participants were assigned to the mindfulness induction and in a negative direction when the mind wandering induction was applied. Examining this pattern further showed that the correlations were no longer significant when the position of the questionnaire was moved to the beginning of the experiment. Regarding the overall effect of mindfulness on persistence with behavioural change, the mindfulness induction led to better performance on the paradigm task in Experiment 2 but not in Experiment 1. Moreover, the overall trait mindfulness scores did not significantly correlate with the paradigm variables. The following section will first focus on the discussion of the unexpected trait mindfulness findings and then on the mindfulness induction results.

## *The unexpected pattern in the results*

As noted above, after finding the unexpected pattern in the results, two result interpretations were suggested. Firstly, it was argued that the results are due to differing

effects the inductions had on people with higher versus lower trait mindfulness. Specifically, the higher trait mindfulness people had, the more they benefited from the mindfulness induction in terms of switching and staying with the novel behaviour. Conversely, the lower trait mindfulness people rated, the more benefit they obtained from the mind wandering induction. However if this were the case then the pattern would remain similar regardless of the position of the questionnaire relative to other tasks. Instead null findings were reported when the questionnaire was moved before the induction and paradigm task. Hence the second interpretation, suggesting the trait questionnaire was influenced by immediate context, is more likely. Concretely, when the trait questionnaire followed the tasks, those who were assigned to the mindfulness condition seemed to have believed their dispositional mindfulness was higher the better they did on the task. On the other hand, people who experienced the mind-wandering condition attributed their success on the paradigm task to deliberating about past or future, hence scored lower on trait mindfulness the better they did on the paradigm task. Thus the cues from immediate context, namely the content of the induction and performance on the paradigm task, directed people's judgment about dispositional mindfulness.

The influence of immediate context on questionnaire measures other than mindfulness has been reported previously. For instance, Schwartz (1984) found that ratings of happiness and satisfaction with one's life were influenced by whether participants were asked to think of positive or negative events. In a different study, people scored higher on sexual arousal when answering questions on a high, fear inducing bridge compared to a low bridge (Dutton & Aron, 1974). In the area of mindfulness, Grossman and Van Dam (2011) pointed out that participating in a mindfulness programme could make one familiar with the language used in this area (e.g. being on autopilot). Consequently, ratings on trait mindfulness questionnaires, which apply a similar style of language, could be higher due to such familiarity as opposed to people having higher dispositional mindfulness. The case that there may be differences between one's perception about mindfulness levels (meta-mindfulness) and actual mindfulness was theoretically discussed before (e.g. Brown et al., 2007; Davidson, 2010). The current study offers experimental evidence for this assumption. The gap between perceived and actual mindfulness may be particularly wide for those with little experience of mindfulness (e.g. Coffey, Hartman, & Fredrickson, 2010; Grossman, 2011). Chiesa (2013) argued that unexperienced meditators might be unaware of not being aware, which was shown

experimentally when American students rated their trait mindfulness higher than Buddhist monks with an average of 15 years of experience (Christopher, Christopher, & Charoensuk, 2009). Hence although it is uncertain whether experience is always crucial for resisting the context, previous theoretical arguments and evidence suggest that having practical experience of mindfulness provides people with better estimates about their actual levels of mindfulness. In other words, those experienced in mindfulness might be more likely to resist the context than mindfulness novices. In the present study, most participants did not regularly engage with contemplative practices. Thus it may be suggested it is likely they were uncertain about their actual level of mindfulness and relied on immediate context to guide their decision.

There is one important implication if it is correct that immediate context influences trait mindfulness scales. Specifically, trait mindfulness questionnaires might not always measure stable characteristics as expected, which would greatly impact most studies conducted in the field of mindfulness. This could particularly be challenging to participants unfamiliar with mindfulness, therefore questions might be raised about whether mindfulness is inherent as suggested by some (Brown & Ryan, 2004) or is gained over time via practice (Giluk, 2009; Grossman, 2010). However as the present findings were unexpected, they should be considered only as preliminary. Future research could investigate the influence of immediate context into greater detail by running controlled studies, which would place this problematic in the forefront.

## *The relationship between mindfulness and persistence*

The influence of the immediate context recorded in the current study leads to uncertainty about the validity of the overall null findings between mindfulness measured by the trait questionnaire and persistence with behavioural change. Thus in the following section, the relationship between mindfulness and persistence will be discussed as assessed by the brief mindfulness induction.

Mindfulness induced by the manipulation was found to produce an effect in Experiment 2. The significant findings in this experiment provide evidence that mindfulness might help persistence with behavioural change. These results are in line with previous findings where mindfulness was shown to be beneficial for behavioural maintenance (e.g. Bowen et al., 2014) or its aspects (e.g. MacLean et al., 2010). The current study offers several clarifications of this relationship. Firstly, as the persistence paradigm simulates the process of behavioural change applicable to various contexts, mindfulness

may enhance not only health behaviour change as was shown in the previous studies but also general behavioural change. Secondly, the current study measured persistence with behavioural change in a controlled, laboratory experiment. This method provides an alternative to self-report measures used commonly. The case that the significant difference was found via a different measure, which may be less prone to biases than self-reports, strengthens the likelihood the relationship between mindfulness and behavioural change indeed applies. Lastly, as the paradigm likely required sustained attention and emotion regulation due to repeated failures, the dimensions of mindfulness involved in behavioural change might be both attentional and attitudinal as Bishop et al. (2004) suggested. However it is also possible that only one of the dimensions stood behind the results. Hence further investigation should determine which dimensions of mindfulness, if not both, are involved in persistence with behavioural change.

Nevertheless, the favourable findings were not shown in both experiments. In Experiment 1, there was no tendency in descriptive statistics or significant relationship suggesting mindfulness is beneficial to persistence with behavioural change. There is a possibility that the findings in Experiment 2 are due to changing the position of the trait mindfulness questionnaire. Specifically, the questionnaire might have acted as a prime for the subsequent choices. As the content of the questionnaire was similar to certain passages of the meditation (e.g. being present, having a non-judgmental stance, observing difficult emotions, etc.), the participants might have concluded that they should choose the harder option in the persistence task. Another possible explanation of the different findings in each experiment is that the mindfulness induction did not produce a strong enough effect to influence persistence in a consistent manner. Studies where the brief mindfulness induction usually produced an effect employed dependent variables measured by short lasting tasks. For instance, Hafenbrack, Kinias, & Barsade (2014) showed a 15-minute induction led to a reduced sunk cost bias which was assessed by making a decision in a hypothetical scenario. Similarly, Erisman and Roemer's (2010) 10-minute manipulation resulted in greater positive affect ratings of positive films. However the dependent variables in the present study were calculated from a task lasting over half an hour during which at least 51 decisions were made. Such a long task may require a stronger mindfulness induction to consistently produce an effect. Therefore, future studies could assess the conditions under which the method of brief mindfulness induction is sufficient to produce an effect.

## *Future research*

There are several suggestions for future research stemming from the present study. These suggestions can be categorised into three groups.

The first group concerns the effect of immediate context on trait mindfulness questionnaires. Specifically, the extent and conditions under which trait questionnaires may be influenced by immediate context could be investigated. For instance, participants would be given a task which leads to either success of failure. This task could be followed by the trait mindfulness questionnaire. It would be researched whether participants in the success condition rate their mindfulness higher than those in the failure condition. Similar variations could be done with making people believe they are more present or deal with difficult emotions in a more functional way. Furthermore, aspects unrelated to beliefs about oneself could be used. For instance, an experimenter displaying different emotions or behaviours could run the study or the laboratory settings would be varied. These kinds of experiments would allow causal conclusions to be drawn about the effect context has on trait mindfulness questionnaires.

The second group of suggestions are about the relationship between mindfulness and behavioural change. To clarify this relationship, future studies could investigate which aspects of behavioural change are affected by mindfulness interventions and to what extent. Possible aspects to consider are emotion regulation or concentration. Further it could be assessed which dimensions of mindfulness affect behavioural change or its aspects.

The last group of suggestions concerns the examination of the mindfulness induction measure. To investigate the strength of the induction effect, variables could be tested on both short and long tasks to determine whether brief inductions are sufficient to produce an effect. In order to deal with the possibility of the priming effect of mindfulness questionnaires and inductions on dependent variables, the induction could be made less transparent. For instance, people would be presented with both mindfulness and mind wandering inductions but in a different order. In between both tasks, there could be filler tasks to increase the elapsed time. Whereas people in the mindfulness condition would receive the meditation recording as the last task, those in the mind wandering condition would receive it as the first task. If people are affected by the induction and not only rationalising the experience, the difference between the two conditions should be apparent.

# Conclusion

To conclude, the study investigated the effect of mindfulness on persistence with behavioural change. Unexpectedly, trait mindfulness scores were associated with performance on the persistence task depending on the mindfulness induction people were assigned to. Specifically, people in the mindfulness condition reported higher mindfulness the better they performed on the persistence task, whereas those in the mind wandering condition reported lower trait mindfulness the more they persisted and succeeded on the task. This could suggest that either people reacted to the induction experience in a different way depending on their trait mindfulness or rated their mindfulness based on the induction experience and performance on the persistence task. Experiment 2 therefore aimed to answer which of the two possibilities is more likely. Moving the questionnaire from the end of the experiment to the beginning produced the null findings, i.e. the unexpected pattern was no longer present. This may suggest people rated their trait mindfulness according to cues from immediate context, namely the induction content and performance on the persistence task.

Future studies should investigate this possibility further. If it were indeed the case that trait mindfulness scores can be influenced by immediate context, measuring mindfulness via questionnaires might not be always accurate. Furthermore, Experiment 2 revealed that the mindfulness induction led to significantly better scores on the persistence task. This may suggest mindfulness enhances persistence with behavioural change, a process leading to behavioural maintenance. The findings would be in line with previous positive results between behavioural maintenance and mindfulness. Additionally, the current findings widen the understanding of this relationship as they apply to general behavioural change and were conducted in a controlled laboratory experiment. However the significant effect of the mindfulness induction was not found in Experiment 1, hence possible reasons behind the null findings, namely the priming effect and strength of the induction, were discussed. Finally, future research suggestions have been made for assessing the influence of immediate context on trait questionnaires, clarifying the relationship between mindfulness and persistence with behavioural change, examining the strength of brief mindfulness inductions, and weakening the priming effect of the induction and trait questionnaires on dependent variables.

# Chapter 5

# The Effectiveness of a "Brief Mindfulness Induction": Review and Evaluation (Study 3)


## Abstract

The brief mindfulness induction methodology has become a popular way of measuring the causal effects of mindfulness in a laboratory setting. The present study reviews 73 peer reviewed articles using this methodology, with various lengths, types, or content of the induction. The results show a great variation in the methodology used, despite a stated common aim of manipulating 'mindfulness'. Specifically, the fit of induction content with the conception of mindfulness is critically examined and two alternative views of what is being manipulated are outlined. The length of inductions is assessed in the light of theoretical arguments and experimental evidence, suggesting longer inductions are more likely to lead to effective mindfulness manipulation. The study recommends improvements to the brief mindfulness induction methodology.


## Introduction

The ancient Eastern construct of mindfulness has been gaining increasing popularity amongst psychological research and clinical communities in recent years. In order to study mindfulness scientifically, suggestions have been made about the definition of mindfulness (e.g. Bishop et al., 2004) whilst measuring tools such as trait mindfulness questionnaires have been developed (e.g. Baer, Smith, & Allen, 2004; Brown & Ryan, 2003).

According to a popular psychological conceptualisation, mindfulness is a multi-dimensional construct, consisting of present moment awareness achieved by regulating one's attention, and a particular orientation characterised by attitudes like acceptance, openness and curiosity (Bishop et al., 2004). However, this conceptualisation of mindfulness is not the only understanding of mindfulness represented amongst the research community. Brown and Ryan (2003) argued for a narrower definition

focussing on of attention and awareness. According to Buddhist traditions, attention and awareness are considered as precursors to rather than parts of mindfulness (Chiesa, 2013; Grossman & Van Dam, 2011) and acceptance is an element of a wider practice (Grabovac et al., 2011), suggesting that neither of the two dimensions defines mindfulness. Hence the understanding of mindfulness is not uniform. Here, for concreteness, we consider mindfulness from Bishop's et al. (2004) perspective.

Mindfulness is assessed as a trait or state where the former is considered as a stable and the latter as a temporary characteristic (Bergomi et al., 2013). In order to examine causal effects of state mindfulness in the laboratory, the method of brief mindfulness induction has been developed (e.g. Arch & Craske, 2006). Brief mindfulness inductions are intended to provide a time efficient way to assess mindfulness interventions, especially when compared to longer inductions like 8-week mindfulness programmes (e.g. Bowen, Chawla, & Marlatt, 2011; Segal, Williams, & Teasdale, 2012). This method involves attempting to induce mindfulness by a short meditation or another exercise assumed to result in such a state. Generally, one half of participants is presented with the mindfulness manipulation whilst the other half complete a control condition. Control conditions include tasks like reading (Petter, McGrath, Chambers, & Dick, 2014) or puzzle solving (Erisman & Roemer, 2010), which are presumed not to lead to a mindful state. After running an induction, dependent variables, which may be, for example, number of cigarettes smoked, ratings of negative affect, or sustained attention, are measured and how they are affected by each of the conditions is statistically compared. If a significant difference between the two conditions is found, it is concluded that dependent variables were affected by mindfulness in a positive or negative direction. Brief mindfulness inductions are most commonly administered in one setting.

The present study is a literature review of the use of the brief mindfulness induction methodology. We examine the length, content, source and type of inductions as well as the experience of participants, the use and content of manipulation checks, and theoretical interpretations of the findings. The main focus is placed on the content and length of inductions. Regarding the content of inductions, the papers are assessed to discern whether mindfulness was induced according to the dimensions described by Bishop et al. (2004). Concerning the length of inductions, a key question is how long is required to induce mindfulness. These two topics are examined further in the discussion section. This section also offers alternative explanations which could affect the results

and how to control for them. Finally, suggestions for improving the brief mindfulness induction methodology are made.

# Method

## *Literature search*

As mindfulness articles come from various fields, a non-subject specific search engine, Google Scholar, was selected to perform the task. There was no starting year specified. The end of 2015 was the end point of the search. The search terms were: mindfulness induction and mindfulness manipulation.

## *Selection criteria*

Three main selection criteria were established to decide which articles from the returned results would be included in the literature review.

### Criterion 1: Journal type

All studies selected were published in peer-reviewed journals.

### Criterion 2: Induction frequency

All inductions had to be presented to participants only on one occasion. Hence, the studies which included repeated inductions were excluded. The studies which consisted of both brief and repeated inductions (e.g. MBSR programme in Farb et al. (2007)) were included but only aspects relating to brief inductions were assessed further.

### Criterion 3: Control conditions

The comparison between control and induction conditions was required, so that studies without a control group were excluded. The control condition could be either neutral, e.g. listening to an audiobook in Grant, Hobkirk, Persons, Hwang, and Danoff-Burg (2013), or considered as an opposite to mindfulness, e.g. mind wandering in Long and Christian (2015). The studies including more than the mindfulness and control conditions, e.g. relaxation in Vinci et al. (2014), were also included.

## *Analyses*

The following categories were analysed. Firstly, the *induction type* (e.g. breathing meditation) was identified. Secondly, the *length of mindfulness induction* was noted.

Thirdly, the *induction content* was assessed in terms of how closely it matched Bishop's et al. (2004) definition of mindfulness, specifically, the presence of the attentional and attitudinal dimensions. Fourthly, the inclusion of a *manipulation check,* a measure which assesses whether mindfulness and mind-wandering were effectively induced[5], and its type was recorded. Fifthly, the presence of the *design source,* i.e. the origin of the induction, was noted. Sixthly, any *previous meditation experience of the participants* was searched for. Lastly, *theoretical interpretation* of the findings was noted.

[5] Manipulation checks tend to be fairly weak or indirect to not affect intervention effects by extensive mindfulness testing.

# Results

## *General*

The search returned 1,034 results. Applying the selection criteria (listed above), 73 articles were chosen for the methodological analysis (see Appendix B). The articles came from 38 different peer-reviewed journals. Most of them were published recently, between 2011 and 2015 (see Figure 1). In order to identify general patterns across the reviewed papers, sub-groups were established for the most categories. Detailed results for each study can be found in the Appendix A.

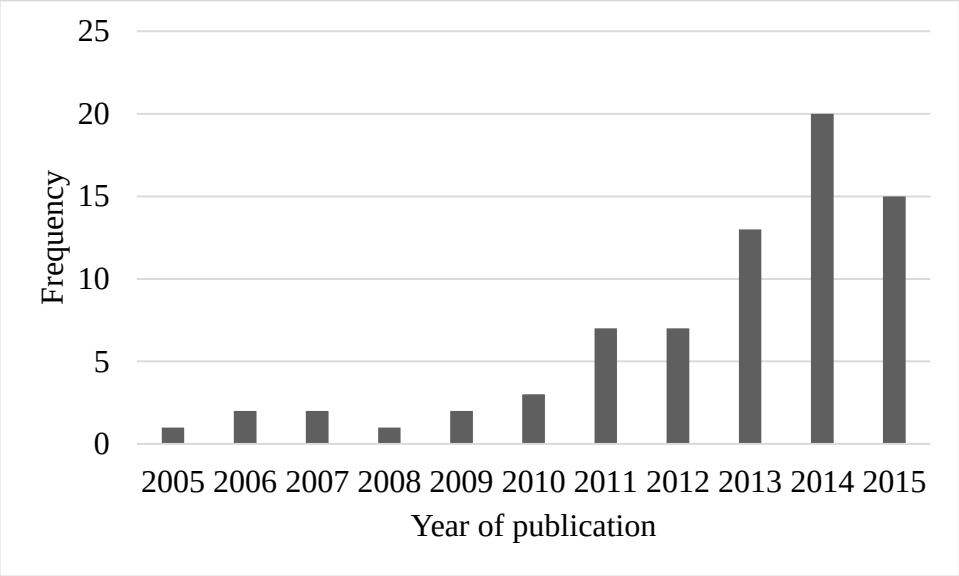



Figure 1. The frequency of articles using the brief mindfulness induction method by the year of publication.

## *Induction type*

In total, eight induction types were identified, some used more commonly than others (Table 1). The majority of them were various kinds of mindfulness meditations where breathing meditations appeared in more than one half of the studies. Some studies used multiple types, e.g. breathing meditation followed by mindfulness of thoughts (Pepping et al., 2013).

Table 1. Induction types identified in the reviewed studies, their description, and frequency representation

| Induction content type | Description | N |
|---|---|---|
| Breathing meditation | a standard type of mindfulness meditation based on observing one's sensations of breathing | 44 |
| Body-scan meditation | a standard type of mindfulness meditation based on observing sensations in different parts of one's body, focusing on one part at a time | 17 |
| Mindfulness of thoughts or emotions | observing one's thoughts or emotions whenever they arise without judgment or further analysis | 8 |
| Raisin eating exercise | engaging each sense at a time whilst observing and eating a raisin | 7 |
| Subject-specific meditation | mindfulness meditation tailored to the main subject of investigation, e.g. observing any cravings appearing at the moment (Cara M. Murphy & MacKillop, 2014) | 6 |
| Mindful prompt reading | being presented with written prompts containing mindfulness instructions like focusing on the present moment, being accepting of anything that arises, etc. | 3 |
| Experiential self-focus | training participants to have a mindful mindset, i.e. focusing on sensing present experience as opposed to elaborating on it | 2 |
| Observing and describing | verbally describing the experience of all that arises | 1 |

## *The length of mindfulness induction*

Table 2 shows the frequency of different induction lengths. The length of inductions, which was 12 minutes on average, ranged from 3 to 45 minutes.

Table 2. The prevalence of induction lengths

| Length (in minutes) | N |
|---|---|
| 1 - 4 | 1 |
| 5 – 9 | 18 |
| 10 – 14 | 28 |
| 15 - 19 | 16 |
| 20 + | 6 |
| NS | 6 |

Note. The total sum of the frequency values is higher than the total number of studies: one study applied varied lengths of the induction at different parts of testing (Reb & Narayanan, 2014) and the other study had two groups of people, each with a varied length of the induction (Bonamo et al., 2015) . NS = the studies either did not specify the length of the induction or the induction was not measured in the units of time (e.g. Papies, Barsalou, & Custers (2012) asked participants to observe their thoughts connected to a series of pictures).

## *Induction content*

Induction content was analysed from induction descriptions included in the method section of each paper. If there was any uncertainty about the presence of the dimensions of mindfulness in the induction procedure, but the procedure was adapted from a previous paper, the texts from both papers were compared and the more detailed description was chosen to determine the induction content in both papers. If there was no previous source of the induction or the source could not be accessed, the induction content was labelled as 'uncertain'.

The induction content findings are presented in Table 2. Around one quarter of the studies focused on the attentional dimension only. Attitudinal dimension was added in around one half of the papers. Some studies did not list attitudes but mentioned a non-judgmental approach towards one's present experience[6]. One study focused on acceptance only.

[6] Although the non-judgmental approach is considered by some as equivalent to acceptance (Ostafin & Kassman, 2012), others understand it as a separate construct (Petter et al. 2014). For that reason, a unique category was created for attention and non-judgment.

Table 3. Frequencies of types of induction content

| Induction content | N |
|---|---|
| Attention only | 19 |
| Attention and attitude | 41 |
| Attention and non-judgment | 3 |
| Acceptance only | 1 |
| Uncertain | 9 |

## *Manipulation checks*

Nearly half of the studies did not apply any manipulation check, although their induction design was often adapted from previous experiments and consequently its prior establishment was assumed. The types of manipulation checks used in the reviewed studies are presented in Table 3. The two most frequently applied types were Toronto Mindfulness Scale (TMS), designed by Lau et al. (2006), and Mindful Attention Awareness Scale-state (MAAS-state), a shorter version of the MAAS trait scale (Brown & Ryan, 2003). Both questionnaires assess state mindfulness. Some studies used different types of manipulation checks. Those varied from study to study. For instance, in one study the authors composed several items examining aspects like the focus of breathing or being in touch with one's body (e.g. Hafenbrack, Kinias, & Barsade, 2014). Other studies used sub-samples of items from trait questionnaires (e.g. Ostafin & Kassman, 2012). Manipulation checks were also performed by raising a hand to a bell sound to assess attentiveness (Grant et al., 2013), taking systolic blood pressure (Larson, Steffen, & Primosch, 2013), or by a qualitative analysis of participants' written descriptions about themselves where the number of words relating to body states and sensory experiences was noted (Zabelina, Robinson, Ostafin, & Council, 2011).

Table 4. The types of manipulation checks and their frequency

| Manipulation check | N |
|---|---|
| TMS | 14 |
| MAAS-state | 8 |
| Other | 19 |
| Not applied | 32 |

Note. TMS = Toronto Mindfulness Scale, MAAS-state = Mindful Attention Awareness Scale (state mindfulness version)

## *Design source*

If applicable, the presence of the design source was noted. The adaptation could have been complete (i.e. all induction transcripts were identical) or partial (i.e. only parts of the transcript were used or only the experimental condition was adapted).

The design sources are depicted in Table 4. Many designs were inspired by previous experiments, most commonly those by Arch and Craske (2006) and Erisman and Roemer (2010). Using transcripts from mindfulness programmes was also popular. Some studies presented an original design.

Table 5. Frequency of design sources of inductions

| Design source | N |
|---|---|
| Arch and Craske's (2006) adaptation | 14 |
| Erisman and Roemer's (2010) adaptation | 3 |
| Other experimental study adaptation | 23 |
| Mindfulness programme | 24 |
| Original design | 9 |

## *Mindfulness meditation experience of participants*

Table 5 shows several groups of participants' previous experience with mindfulness meditations, as enquired in the reviewed studies, as well as the overall representation of each group. Most studies did not specify such experience. It is likely that, where prior experience is not mentioned, most participants were novices, given the relatively low prevalence of mindfulness experience in the student and general populations. Around one quarter of the studies noted that most participants were novices. The remainder of the studies were recording the regularity of meditative experience (Prins, Decuypere, & Van Damme, 2014), previous formal training in mindfulness meditations (Michal et al., 2013), or were ensuring a range of experience was represented amongst the participants (Petter et al., 2014).

Table 6. The frequency representation of the kinds of participants' previous experience with mindfulness meditations

| Participants | N |
|---|---|
| 60-100% novices | 20 |
| Most not regular meditators | 1 |
| No formal training | 1 |
| Range of experience | 1 |
| Not specified | 50 |

## *Theoretical interpretation*

The vast majority of the studies attributed the results of brief mindfulness induction to mindfulness or made further specifications relating to this concept (e.g. mindful breathing, attention, eating, or self-focus). Three studies labelled their findings as focused breathing or attention (Arch & Craske, 2006; Dickenson, Berkman, Arch, & Lieberman, 2012; Miller, Lefebvre, Lyon, Nelson, & Molet, 2014) whilst one study made attributed their findings to relaxation (Cropley, Ussher, & Charitou, 2007).

# Discussion

Although the vast majority of the reviewed studies attributed their findings to mindfulness, great variation was displayed in the type, length and content of induction, as well as manipulation checks and design sources. Some categories including the participants' experience with mindfulness or manipulation checks were in large parts not recorded. The following section will discuss the issues surrounding the two assessed categories: content and length of inductions.

## *Content variation*

The two most represented types of induction content included either both dimensions of mindfulness, as defined by Bishop et al. (2004), or the attentional dimension only. In the former case, it is assumed mindfulness is induced by focusing on the dimensions of attention and attitude:

> "Participants in the mindfulness conditions were instructed for approximately 12 min to focus their attention on their breathing …. Moreover, when intrusive

> thoughts arose, they were asked to notice them, accept them without judging ….” (Alberts & Thewissen, 2011, p. 74-75).

Although both dimensions are included in an induction, it is possible that only one of them is contributing to the effect. In order to present that both dimensions are involved, it may be useful to test first whether each of them can be induced in a brief setting. If both dimensions contribute to the effect found, it may be important to determine whether they are mutually independent and to what extent each dimension should be represented to create mindfulness[7]. Their interaction can also be a relevant aspect.

The second type of induction content aimed to induce mindfulness by focusing on the attentional dimension:

> “For the mindfulness practice group, the participants were required to sit quietly with eyes closed and to concentrate on deep breathing for five minutes” (Kuo & Yeh, 2015, p. 103).

This understanding of mindfulness differs from Bishop's et al. (2004) conceptualisation as the orientation characterised by attitudes like acceptance, curiosity, and openness is not included. As suggested in some reviewed papers (e.g. Chong, Kee, & Chaturvedi, 2014), the reason behind opting for only the attentional dimension in inductions stems from the conceptualisation of mindfulness presented by Brown and Ryan (2003). According to these authors, mindfulness is a state of being highly attentive and aware of the moment to moment experience where acceptance is already embedded into the attentive state. Whether or not mindfulness can be equated with attentional processes without the inclusion of acceptance has been discussed elsewhere (e.g. Cardaciotto et al., 2008; Coffey, Hartman, & Fredrickson, 2010). However in the context of brief mindfulness inductions, the two different conceptualisations, each comprising of varied number of dimensions, are used to measure mindfulness. Yet most effects found are being singularly labelled as mindfulness, which could lead to imprecisions in inferences made about brief induction results.

## Alternatives to mindfulness as a mediator of the experimental manipulation

There is also possibility that the effects found in brief inductions could be explained by concepts different to mindfulness. The following section will focus on two alternatives,

[7] Similarly, Chiesa (2013) and Christopher et al. (2009) discussed issues with combining facets of a trait mindfulness questionnaire to capture mindfulness.

namely focused attention or concentration, and expectations from the induction experience.

### *Alternative 1: Focused attention or concentration*

One of the early papers applying a brief mindfulness induction ascribed their results to focused attention (Arch & Craske, 2006). Focused attention can be understood, roughly, as concentration (APA Concise Dictionary, 2009).[8] Concentration is believed by some to share a common ground with mindfulness, for example in strengthening attention (Dreyfus, 2011). Yet mindfulness is considered as a wider concept. For instance, apart from consisting of the attitudinal dimension, others noted it includes top-down, cognitive functions like making sense of an object (Dreyfus, 2011) and insight (Grabovac et al., 2011). A suggestion of why concentration could stand as a more suitable explanation of an effect in inductions is offered in several studies from the literature review:

> "… a true induction of mindfulness would likely require extensive training in mindfulness" (Arch & Craske, 2006, p. 1850).[9]

> "It was necessary to teach concentration meditation first because it taught students how to "quiet" their minds. Without this training, it is difficult, if not impossible, to train mindfulness meditation" (Dunn et al., 1999, p.150).

Hence modulating concentration may be easier than it is to modulate mindfulness; or perhaps the former is a precondition to the latter. If these assumptions are correct, then findings of the studies which focus on the attentional dimension could be attributed to concentration. The same could apply to inductions focusing on both dimensions if the attitudinal dimension was found to have no effect. To disentangle the effects of concentration from two dimensional mindfulness, a third condition could be included to differentiate one construct from another. Johnson, Gur, David, and Currier (2013) ran their experiment with three conditions: mindfulness, sham mindfulness, and a control.

[8] This understanding of concentration is much narrower and somewhat different from the Buddhist conceptualisation, which does not consider concentration as an ethically neutral concept or as being present without a training over a long period of time (Bodhi, 1998).

[9] Interestingly, the methodology of this paper was also the most common experimental adaptation in the subsequently reviewed papers. Nevertheless, only one of those studies made the same result attribution, i.e. to focused attention (Dickenson et al., 2012), whilst the remainder ascribed their findings to mindfulness.

The mindfulness condition focused more on acceptance and observation of the current experience, whereas the sham mindfulness condition centred on focused breathing only. Although both the mindfulness and sham mindfulness conditions performed better than the control condition on mood ratings, there were no significant differences between them, suggesting the effect was likely to due to their shared characteristics, possibly attention regulation. Of course, this is not to say that the effects of mindfulness would not have unique contributions in different cases. Nevertheless, without running a concentration condition alongside with a mindfulness condition, induction results could be attributed to either of the concepts.

### *Alternative 2: Expectations resulting from the induction experience*

The second possible explanation for the effects found could be partially or fully explained by effects on participants' expectations. Specifically, the content of an induction might have led people to make inferences about how they should respond, which will in turn modify the dependent variables of interest. For instance, participants in the mindfulness condition might believe they are expected to be non-judgmental and select an answer which reflects such an attitude.

Consequently, findings could be caused by an interpretation of as opposed to the actual induction experience. Some studies could have also increased people's expectations by including information about mindfulness or its connection to assessed variables to induction instructions. Here are some examples:

> "The mindfulness intervention consisted of audiotaped information about mindfulness, ..., information about the application of mindfulness principles to emotional experiences, …" (Erisman & Roemer, 2010, p. 76).

> "Mindfulness means fully experiencing what happens in the here and now; in other words, it means focusing our minds on what is happening in and around us at this very moment. It is a technique that encourages you to stop and smell the roses" (Heppner et al., 2008, p. 492).

The study in the first example measured emotional responding to film clips. Thus if participants in the experimental condition were given cues of how mindfulness could influence emotions, they might have made inferences about how to respond to a clip. The second example presents a study measuring aggressive behaviour. Again including phrases like "to stop and smell the roses" might influence people's expectations and

modify their subsequent behaviour. To reduce the effect of expectation, the information about mindfulness and its function in experimental conditions could be either avoided (e.g. Marchiori & Papies, 2014) or included in both the experimental and control conditions. The latter idea would ensure both conditions were very similar with the exception that the experimental condition would also include the experiential dimension of a meditation.

The other way to control for the effect of expectations is to employ a manipulation check. The majority of studies administered self-reported manipulation checks, most commonly the Toronto Mindfulness Scale (TMS) and the Mindfulness Attention Awareness Scale – state version (MAAS-state). However these scales have some issues which may affect the effectiveness of testing of brief inductions. Regarding the TMS scale, Bishop's et al. (2004) attentional dimension was not completely supported by the scale validation results (Chiesa, 2013; Lau et al., 2006). As the attentional dimension is present in most of the reviewed brief induction studies, the TMS might not be a suitable manipulation check applied to this methodology. Regarding the MAAS-state, Chiesa (2013) pointed out that increased mindfulness as reported in the MAAS could be attributed to other explanations such as expectations or mindfulness terminology exposure rather than to the effect of the practice itself. This is due to the absence of a control group in the testing of the validity and reliability of the MAAS (Chiesa, 2013). Moreover, previous studies showed that people's beliefs about the levels of their mindfulness do not always correspond to the actual levels of mindfulness. Specifically, university students, mostly inexperienced in meditation, rated their trait mindfulness higher on several facets of a mindfulness scale than Buddhist monks with an average meditation experience of 15 years (Michael S. Christopher et al., 2009). Hence a focus of future investigations could also be placed on developing different types of manipulation checks to self-reports such as behavioural (e.g. a sustained attention test) or biological measures (e.g. an event-related potential (ERP)).

## *Length of induction variation*

The common theme appearing throughout this section is the length of brief mindfulness inductions. So far, it has been discussed whether the manipulation is long enough to induce both attention and attitudes of acceptance, or whether concentration would not be a more suitable explanation than mindfulness as the former might require less training. Possibly, one could also argue that the longer people practise mindfulness, the

more likely the actual effects of mindfulness occur rather than the results being caused by expectations. Yet how long should a brief mindfulness induction be to result in mindfulness?

Considerable variation in the induction length was displayed across the reviewed studies. For example, the shortest induction was a 3 minute raisin eating exercise (Reb & Narayanan, 2014) and the longest a 45 minute body scan meditation (Bonamo, Legerski, & Thomas, 2015). Is the effect of the former equivalent to the latter? Perhaps there is a degree of mindfulness which steadily raises with increasing induction time. Other possibilities are that the effects of the shortest and longest inductions are qualitatively different (e.g. the former leading to concentration and the latter to mindfulness), or neither of them induce the kind of mindfulness which would be comparable to the mindfulness developed over a longer period of time by repeated practice.

Examining theoretical discussion on the length of mindfulness, some argue that long periods of time are necessary for mindfulness cultivation (e.g. Chiesa, 2013; Grossman, 2010). Grossman & Van Dam (2011) state that even the simple form of mindfulness practice, mindfulness of breath, which was applied in more than half of the reviewed studies, requires time. The same is also argued in one of the earliest Buddhist texts, Sattipatthana Sutta (Jotika & Dhamminda, 1986). Assessing experimental evidence, Kiken, Garland, Bluth, Palsson, & Gaylord (2015) found that the development of state mindfulness varies individually. However with increasing time, such development might be more likely. Moreover, Lush et al. (2009) shed some light on the strength of the effect of brief mindfulness inductions. The authors took physiological measures in patients with fibromyalgia, a chronic pain disorder, before and after an 8-week long MBSR (Mindfulness-Based Stress Reduction) programme. At these two time points, the measures were recorded at the baseline and after a brief induction. Significant differences in skin conductance levels (SCL) were found before and after the MBSR programme. However SCL were not affected by the brief induction when compared to the baseline at both time points. Thus in this case, the effect of brief mindfulness induction was minimal compared to the effect of the weeks-long mindfulness course. Lush's et al. (2009) experimental design is an example of examining whether the effects of brief inductions are comparable to different measures of mindfulness. Hence to answer the question about how long the induction should be, longer inductions might be more effective to result in mindfulness, considering individual differences in the

development of state mindfulness as well as the theoretical arguments and experimental evidence. At this point, however, it has yet to be demonstrated that a state of mindfulness can rapidly be induced in a single experimental protocol.

## *Recommendations for future work*

Although the brief mindfulness induction methodology potentially represents a time-efficient way of acquiring evidence about causal relationships between mindfulness and variables of interest, there are substantial uncertainties about its validity. The main concerns raised here are the variability of induction content, the possibility of alternative explanations and the uncertainty that inductions of varying lengths lead to a comparable effect. However a number of suggestions, summarised below, could help to reduce some of the concerns raised.

(1) Assessing the effects at different time points of brief mindfulness inductions (e.g. at 5 minute increments) as well as comparing brief mindfulness inductions to other forms of mindfulness measurements (e.g. 8-week mindfulness programmes, experienced meditators, etc.) may be useful. It could be reasonably expected that the effect increases with the length of an induction or practice, although the results at two different points could also be qualitatively different.

(2) In order to discern whether the results are caused by enhanced focused attention or to additional characteristics defining mindfulness (e.g. acceptance), a condition focusing solely on concentration could be added and compared to the experimental condition of mindfulness.

(3) To reduce the influence of expectations, mindfulness related information could be included in both the experimental and control conditions. Alternatively, such information could be avoided altogether to ensure inferences about the experimental experience are minimised as much as possible.

(4) A focus could also be placed on developing new forms of manipulation checks to decrease the effect of expectations (e.g. a behavioural or physiological correlates).

Concerning the conceptual underpinning of brief mindfulness inductions, difficulties arise from different understandings of mindfulness amongst the research community. Reaching a consensus would ensure future findings were attributed to the same concept. If the consensus is that mindfulness equals the attentional dimension only, then the

discussion and experimentation could be centred on what makes such understanding of mindfulness different from concentration. If the attitudinal dimension is included in the conceptualisation of mindfulness, then induction studies could measure the effects of attention and attitudes separately to disentangle which dimension affects the results. Subsequent investigation would then focus on how these two dimensions combine together to create mindfulness or how they interact. If this is found to be challenging, then conclusions for each dimension separately as opposed to mindfulness as a whole concept could be drawn. A similar suggestion was already made by Chiesa (2013) regarding reporting the results for different facets of mindfulness. If the consensus about what constitutes mindfulness cannot be reached, then a different label for each understanding of mindfulness could be applied (e.g. one dimensional mindfulness versus two dimensional mindfulness). Then two streams of research would be conducted, each with a separate concept. To summarise, in order to improve the brief mindfulness induction measure, a number of methodological adjustments can be made. Yet regardless of the methodology applied, agreeing on what conceptually defines mindfulness is crucial to bring clarity on what is being measured.

# Conclusion

The present literature review aimed to investigate the use of the brief mindfulness induction methodology. A literature review of the studies previously applying this method was employed. The literature review identified a fast-increasing number of studies with brief mindfulness inductions. A high variability in many methodological categories of interest was displayed. The variability discussed in this study was that of content and length of inductions. Regarding the varied content of inductions, some studies measured mindfulness as an equivalent to the attentional dimension, whereas other papers focused on attentional and attitudinal dimensions of mindfulness as defined by Bishop et al. (2004). Each conceptualisation of mindfulness carries its own challenges, yet giving them both the same label could make inferences about the concept of mindfulness ambiguous. It is also possible other variables than mindfulness mediate the relationship between the manipulation and dependent variables. The present study discussed concentration or focused attention as one of the variables. Furthermore, the methodology may be fully or partially ascribed to the role of expectations. However, the study presented ways to control for both possibilities. The second variability

examined was the length of inductions. Theoretical discussion supports the idea that mindfulness requires time to develop, hence the longer inductions should more likely result in mindfulness. Nevertheless, such length might be difficult to determine, especially in the light of individual differences in the development of state mindfulness. Despite its appeal, further investigation into the brief mindfulness induction methodology is required before it can be concluded it leads to a state of mindfulness.

# Chapter 6

# Conclusion

The main themes of the present thesis were mindfulness, its methodology and influence on the paradigm of persistence with behavioural change. The themes were investigated across three studies. The studies were preceded by a chapter including a more general literature review to provide a wider context about the forthcoming topics.

The aim of the current chapter is to summarise each individual study and discuss its contributions to theory and practice.

## Study 1: Paradigm of Persistence with Behavioural Change

Study 1 introduced the paradigm of persistence with behavioural change. The paradigm is a laboratory simulation of real-world persistence with behavioural change, that is, how consistently people stay with a changed behaviour as opposed to return back to the original, habitual behaviour. Although persistence with behavioural change is similar to other concepts like grit (Duckworth et al., 2007), learned industriousness (Eisenberger, 1992), and self-control (Ainslie, 1975), it is unique as the focus is narrower and it is more generally applicable. The paradigm involves a repeated choice between completing a behaviour in a habitual way, characterised by payoffs which are small but easy to achieve, or in a novel way which leads to higher payoffs that are difficult to obtain at first, requiring a degree of persistence. Thus participants were asked to work on a task involving the completion of paths using keyboard in a usual or novel way. In line with the phenomenon of relapse during real behavioural change, people could switch back to the habitual option whilst working on the paths. Participants were informed that persistence with the novel option lead to the greatest outcomes for most of those who completed the task previously. The case the participants knew the optimal strategy of the task was the key aspect distinguishing the paradigm from other similar tasks like the IOWA gambling task and the melioration task. The results showed substantial individual differences in the way people responded to the paradigm. A slightly larger group of participants decided to stay with the habitual behaviour or

returned to it during the task rather than persisted with the novel alternative. Of course, it seems plausible that similar individual differences arise in real-world behavioural changes, such as smoking cessation or changing work patterns.

Minimising the value of the habitual option, thereby making it less attractive, increased participants' persistence with behavioural change, suggesting a possible application of the paradigm. There are further ways in which the paradigm could be used. The study listed three possibilities, the first of which was changing the reward values and frequencies to explore how to make the habitual behaviour less attractive or the novel behaviour more motivating. The second possibility was to adjust information about the optimal strategy or omit it altogether in order to observe the effect of information on behavioural change. The last suggested application was to test the impact of further variables on the paradigm, for instance, affective valence, self-efficacy, and peer effect.

The study also dealt with suggestions for construct validity. Several methods of testing were suggested. Firstly, high correlations between persistence with behavioural change, sustained attention, and emotion regulation were expected. Secondly, the results from the paradigm could be compared to the results from similar tasks such as persistence tasks or the IOWA gambling task. Thirdly, it could be assessed whether specific groups respond to the paradigm in a certain way. For instance, smokers might show less persistence with behavioural change than non-smokers. Fourthly, the results on the paradigm could be compared to neuroimaging data, particularly to activation in the frontal cortex, an area that has been associated with self-control. Lastly, certain adjustments in the paradigm could ensure testing for reliability over time.

Several limitations of the paradigm of persistence with behavioural change were described, including the lack of complexity of the paradigm and the nature of reward values. Future research was suggested, particularly to test for construct validity, assess various applications and use the paradigm to complement existing measures of behavioural change.

## *Contributions of Study 1: Paradigm of Persistence with Behavioural Change*

There are several contributions Study 1 brings. Firstly, persistence with behavioural change is introduced as a new concept. Compared to other similar concepts, persistence with behavioural change has a narrower temporal focus and more general applicability. That may be useful when researchers wish to experimentally examine only the initial

phase of behavioural change, characterised by frustration over the lack of rewards of the changed behaviour and the desire to go back to the habitual behaviour with predictable rewards, whilst applying it to any subject domain. From a theoretical point of view, having a concept with a narrow focus might also help to distinguish between relapse that happened during the initial phase, as opposed to at any time after behavioural change initiation regardless of whether the new behaviour has or has not become rewarding. The general applicability of persistence with behavioural change also enables a theoretical discussion about the initial phase of behavioural change without reference to a specific context.

The second contribution of Study 1 is to introduce a novel methodology for measuring behavioural change via the paradigm of persistence with behavioural change. The paradigm has several advantages. Firstly it represents a simulation of real-world behavioural change, thus it creates a micro-world of the key features that are happening during the process of behavioural change. The most important features include a choice between a habitual and novel alternative, short-term attractiveness of the habitual option and long-term appeal of the novel option, the frustrating nature of the change involving failures to succeed with the novel behaviour, persistence with the novel behaviour being necessary for its mastery, and an ever-present option to relapse. Using laboratory simulations of real-world phenomena is not uncommon. This method has been applied by leading researchers (Pollack, 2013), as it provides an effective tool in assessing complex issues in a way that is time-efficient and controlled. Secondly, the paradigm allows measurement of both the overall outcome of behavioural change but also its process for each individual. Specifically in terms of outcome variables, the paradigm can assess i) the total number of trials on which a novel alternative was chosen, ii) the total number of trials on which people switched to the novel option but did not relapse back to the habitual option during the trial, and iii) the number of trials on which people succeeded with the novel option. Regarding the measurement of the process of behavioural change, the paradigm allows for an individual examination of decision patterns made across the trials, the conditions under which participants relapse, and how success influences their subsequent choices. Thirdly, the paradigm can be applied in numerous ways, making it highly flexible. This is because certain features of the task can be adjusted or omitted altogether. For instance, the values of the rewards and their frequencies can be changed, the task can be made easier or harder by selecting a different time limit or making the novel behaviour more difficult (e.g. rotating all the

arrow keys by 90 degrees), the relapse feature can be removed, or information about the optimal strategy edited. Researchers can adjust the paradigm to their needs and also test the effect of various variables on the paradigm by adding a manipulation before the paradigm or in form of feedback in between the trials. This way, factors that hinder or aid behavioural change can be assessed.

Overall, the paradigm can be used in three ways. The first way is to run it as a single method to test various hypotheses in a laboratory environment. The controlled environment of a lab reduces the noise readily present in field studies and also provides a cost-effective way of investigating factors of behavioural change. Alternatively, running the paradigm in a laboratory can constitute the first step of examination where it would act as pre-test to a field experiment. This way, assessing research questions on the paradigm could determine which factors are worth investigating further in the field. Thus the second way of using the paradigm is as a way of filtering what hypotheses will be assessed in the field, thereby saving money and time. The third way is to apply the paradigm as a complementary tool run alongside other measures of behavioural change such as self-reports. Using the paradigm in this way would provide a comparison of results between different measures, thus increasing their validity.

To summarise, Study 1 introduces the paradigm of persistence with behavioural change as a novel way to measure persistence with behavioural change. Working on the paradigm, which presents a repeated choice between the habitual and novel behaviour where the latter requires a degree of persistence to succeed, showed high individual differences in the strategies applied despite the optimal strategy being disclosed to participants prior to the task. Suggestions for paradigm applications and construct validity were provided. Study 1 offers several theoretical and methodological contributions. Persistence with behavioural change represents a concept with a narrower focus and more general applicability, providing advantages for testing and theoretical discussions. The paradigm of persistence with behavioural change offers a novel way of assessing the initial phase of behavioural change via a lab simulation of the real world which enables measurement of both the process and outcomes of behavioural change, and can be adjusted in multiple ways. The paradigm can be run as a method in its own right, as pre-test to field experiments, or as a complementary tool to other measures of behavioural change.

# Study 2: The Influence of Immediate Context on a Trait Mindfulness Questionnaire

Study 2 assessed one of the applications of the paradigm of persistence with behavioural change, namely how mindfulness can affect people's responses on this task. There are multiple definitions of mindfulness across the literature, but here it is defined as present moment awareness with the attitudinal orientation of acceptance, openness, and curiosity (Bishop et al., 2004). There are several reasons why mindfulness could potentially affect persistence with behavioural change. Previous studies found a link between mindfulness and behavioural change maintenance. Mindfulness was also linked to sustained attention and emotion regulation, both of which may be required for persistence with behavioural change. However Study 2 offered to measure behavioural change via a behavioural task in a controlled, laboratory experiment, thus providing a comparison to more traditional measures of behavioural change such as self-reports. Behavioural change was thus assessed using the paradigm of persistence with behavioural change. Before participants started working on the trials requiring a choice between the habitual and novel behaviour, mindfulness was induced via listening to a recording. Specifically, participants in the experimental condition were presented with a standardised mindfulness meditation recording, whilst people in the control condition listened to a series of simple questions about their past recollection or future plans. Whilst the experimental condition aimed to induce mindfulness, the control condition led to mind-wandering, a state in which awareness is not present-centred. Mindfulness was also assessed as a trait by administering the CAMS-R trait mindfulness questionnaire after people finished working on the paradigm. It was the relationship between trait mindfulness and the paradigm variables that showed some unexpected results. Specifically, higher trait mindfulness was associated with a tendency to switch, persist and succeed on the paradigm, but only for those who were assigned to the mindfulness condition. Participants in the mind-wandering condition reported higher trait mindfulness the less they switched to the novel option, persisted and succeeded with it. One of the possibilities was that the questionnaire ratings were influenced by immediate context, namely the induction condition and performance on the paradigm. Therefore, the second experiment was run with the trait questionnaire positioned before the paradigm. The second experiment showed that the pattern was no longer present when the position of the trait questionnaire was adjusted. This suggested the ratings on the trait mindfulness questionnaire could be influenced by immediate context. Study 2

listed two main implications of these findings. Firstly, the perception of one's mindfulness might not be the same as the actual levels of one's mindfulness. Secondly, trait mindfulness questionnaires might consequently not measure stable characteristics.

Concerning the effect of the mindfulness induction on the paradigm variables, a significant relationship was found in the second experiment. If the findings of the second experiment apply, it would mean that the study showed an effect of mindfulness on general behavioural change, not only on behavioural change from health domains. Finding the relationship in a controlled experiment strengthens previous results which applied different measures. Nevertheless, a significant relationship was not found in the first experiment. Two reasons for this inconsistency between the two experiments were discussed. The first reason is that the mindfulness induction was not strong enough to produce a consistent effect on the paradigm. The second reason is that the findings in the second experiment could have been enhanced by expectations of how one should respond on the paradigm. Such expectations may have been created as a result of similarities in language of the mindfulness induction and trait mindfulness questionnaire.

Lastly, Study 2 offered several suggestions for future research. The effect of immediate context on trait mindfulness questionnaires could be investigated further, especially in order to draw causal conclusions about the relationship. It could also be assessed which aspects of behavioural change are affected by mindfulness and which dimensions of mindfulness play a role in behavioural change. The question whether the brief mindfulness induction produces a sufficiently strong effect could also be addressed. The way brief inductions are administered could be adjusted to reduce the influence of other measures like trait mindfulness questionnaires.

## *Contributions of Study 2: The Influence of Immediate Context on a Trait Mindfulness Questionnaire*

As with Study 1, Study 2 has both methodological and theoretical contributions. Regarding the methodological contributions, the case that the trait mindfulness questionnaire was likely influenced by immediate context provides experimental data to complement questions raised previously, specifically whether mindfulness is an inherent construct (Brown & Ryan, 2004), thus can be measured as a trait regardless of people's experience, or is gained over time with practice (Giluk, 2009). Some researchers also pointed out that language familiarity of those who participated in

mindfulness courses might impact responses on trait mindfulness questionnaires (Grossman & Van Dam, 2011). If the participants in the present study adjusted their responses based on cues from immediate context, this suggests they did not know how mindful they were. In other words, participants' perception about mindfulness levels, namely meta-mindfulness, differed from the actual levels of their mindfulness. Hence, Study 2 also provides experimental evidence regarding the debates in mindfulness research circles about the difference between mindfulness and meta-mindfulness (e.g. Grossman & Van Dam, 2011). There are numerous trait mindfulness questionnaires that have been developed and used widely to assess effects and stable characteristics of mindfulness (Bergomi et al., 2013). Consequently, it is important to understand to what extent these questionnaires can be influenced by immediate context. Study 2 suggests further investigation of this issue that could contribute to the development of more precise measures of the mindfulness construct.

The second area of methodological contributions of Study 2 relates to questions whether brief inductions produce a state of mindfulness. It is probable that the content of inductions combined with the content of trait mindfulness questionnaires led to expectations about how one should respond on the task. This possibility should be researched further. Additionally the current study raises questions about the strength of the effect brief mindfulness inductions produce. Previous investigations showed mixed results when briefly induced mindfulness was applied to influence behavioural change (C. M. Murphy & MacKillop, 2014; Ussher et al., 2009). Hence it is possible mindfulness induced briefly is too weak to affect behavioural change.

The theoretical contributions of Study 2 concern the relationship between mindfulness and persistence with behavioural change. The study provides further experimental evidence supporting the relationship between mindfulness and behavioural change. This link was found when mindfulness was measured via trait questionnaires (Black et al., 2011), at the end of eight weeks long programmes (Sarah Bowen et al., 2014), or induced briefly in the lab (Ussher et al., 2009). Nevertheless, behavioural change assessed in Study 2 offers some new theoretical insights. Firstly, the scope of behavioural change, which includes behavioural change initiation and maintenance (Michie, West, Campbell, Brown, & Gainforth, 2014), is narrowed to persistence with behavioural change which focuses on maintaining behavioural change in its initial phase. Secondly, behavioural change in the present study was assessed via the paradigm in a controlled laboratory environment in contrast to using self-reported measures (e.g.

Cropley, Ussher, & Charitou, 2007). Thirdly, behavioural change measured by the paradigm allows conclusions to be drawn about behavioural change in general as opposed to behavioural change in a specific domain, particularly the health domain on which previous studies focused (e.g. Bowen et al., 2009).

To summarise, Study 2 assessed the link between mindfulness and the paradigm of persistence with behavioural change where the former is measured via trait mindfulness questionnaires and also induced briefly in the lab, and the latter assesses persistence with behavioural change. The relationship is supported in one of the two experiments. More importantly, an unexpected pattern between the trait mindfulness questionnaire, brief induction, and performance on the paradigm is revealed, suggesting the possibility that self-reporting on the the trait mindfulness scale was influenced by immediate context. This influence is a key methodological contribution of Study 2. Questions raised about the strength of brief mindfulness inductions provides the second methodological contribution. In terms of its theoretical contribution, Study 2 adds evidence supporting the relationship between mindfulness and behavioural change, and makes further specifications of the kind of behavioural change that was influenced by mindfulness.

# Study 3: The effectiveness of a "brief mindfulness induction": a review and evaluation

Study 3 presented a literature review of the brief mindfulness induction methodology and subsequent discussion of several aspects that were revealed through the analysis. Brief mindfulness induction is a time and cost-efficient way to assess mindfulness where its state is induced by a short meditation or other exercise.

The literature review focused on several aspects of the methodology, namely the length, content, source, and type of inductions, experience of participants, the use and content of manipulation checks, and theoretical interpretations of the findings. In total, 73 articles were selected for further analysis. The analysis revealed a number of induction types, including meditation of breath, body-scan, and mindfulness of thoughts. The length of induction ranged from 3 to 45 minutes. The content matched different conceptualisations of mindfulness, mostly those by Bishop et al. (2004), and Brown and

Ryan (2003). Manipulation checks were not readily used, but if they were, different types were employed. The source of the design adaptation was also noted. Participants' experience with mindfulness was often not recorded. Results of the studies were most commonly attributed to mindfulness or its specification, such as mindful breathing. Thus great variation was displayed across different aspects of the brief mindfulness induction methodology. Further discussion focused on two methodological aspects: the content of inductions and their length. The content of inductions was most commonly based on the mindfulness conceptualisation including the attentional aspect (Brown & Ryan, 2003), or both the attentional and attitudinal dimensions (Bishop et al., 2004). If one-dimensional mindfulness applies, it should be explained how it differs from focused attention. If two dimensions constitute mindfulness, it should be determined whether each can be induced in a brief setting, to which extent it is represented, and whether both dimensions are mutually independent. The crucial issue of the induction content topic was that most results, regardless of the chosen conceptualisations, were labelled as mindfulness.

The discussion of Study 3 further offered two alternatives that could explain the effect found instead of mindfulness. The first alternative suggested was focused attention or concentration which, as some suggested, might be easier to induce than mindfulness. The second alternative was expectations from induction experience, where the actual content of induction or information that is given about mindfulness could result in inferences about the right way of responding to subsequent questions. Regarding the variation in the length of induction, it is uncertain how long a brief induction should actually be to result in mindfulness. Theoretical discussions suggested that long periods of time are necessary to cultivate mindfulness. Experimental evidence showed individual differences in the development of state mindfulness, thus longer inductions might be safer to apply than shorter inductions to result in mindfulness even in novices. Nevertheless, it is crucial to first show mindfulness can be induced in a brief setting.

Study 3 concluded with suggestions for improving some of the issues raised. Firstly, the findings from brief inductions could be compared to other measures of mindfulness to ensure the results are not qualitatively different. Secondly, induction effects could be compared at different time points during the induction. Thirdly, a focused attention condition could be run alongside the mindfulness and control conditions to distinguish between the effect of mindfulness and concentration. Fourthly, the way information is displayed in the induction content and its instructions could be controlled to reduce the

effect of expectations. Fifthly, behavioural and physiological manipulation checks could be further developed. Lastly, consensus should be reached about what mindfulness is, subsequently clarifying uncertainties associated with each definition. Alternatively, if consensus cannot be reached, each understanding could obtain a different label to differentiate what concept a particular finding is associated with.

## *Contributions of Study 3: The effectiveness of "brief mindfulness induction": A review and evaluation*

Study 3 has both theoretical and methodological contributions. Regarding the former, Study 3 provides a concrete example, i.e. brief mindfulness induction methodology, of how important it is to have a consensus on the concept of mindfulness. Without such a consensus, inferences drawn about mindfulness originate from multiple definitions of this concept, which ultimately undermines its credibility. Should a particular definition be selected, the study describes what aspects of a chosen conceptualisation need to be clarified further. Specifically, if mindfulness is to consist of the attentional dimension only, it needs to be explained how it differs from focused attention or concentration. If mindfulness also includes the attitudinal dimension, it is necessary to explain the relationship between the two dimensions in greater detail, particularly their mutuality and individual contribution to mindfulness, in order to allow for more precise quantitative assessment.

Methodologically, Study 3 provides, to my knowledge, the first literature review of the brief mindfulness induction methodology. This kind of literature review gives an overview of how the method has been applied so far. Apart from its informative value for mindfulness research, the literature review can serve as a guide for those who wish to induce mindfulness briefly in future studies. It may assist them in deciding about particulars of their experimental design. Furthermore, Study 3 points out two other alternatives to mindfulness to which the findings could be attributed, namely concentration and expectations. Suggestions are made for adjusting the standard experimental design to distinguish between the effects of mindfulness and concentration. To reduce the influence of expectations, controlling for information in the induction content is recommended. Hence the proposed ideas could help to increase the chances that the effect is a result of mindfulness. These suggestions alongside the further recommendations proposed in Study 3, particularly those related to the length of inductions, enable the improvement of the brief mindfulness induction methodology in

future studies. Overall, the great variation recorded across the studies using brief inductions could serve as a call for the development of a more standardised use of this method.

To summarise, Study 3 presented a literature review of the brief mindfulness induction methodology, a popular, time-efficient way to induce a state of mindfulness. The review assessed various methodological aspects of brief inductions. High variation was displayed across the studies. Further discussion focused on two aspects, content of inductions and their length, and difficulties associated with them. Improvements of the method were also provided. Both theoretical and methodological contributions of study 3 were discussed. Theoretical contributions centre on the need for consensus in the understanding of mindfulness and the study also offers suggestions in case a consensus cannot be reached that could reduce confusions about the use of the mindfulness term in the literature. Methodological contributions include the literature review findings, highlighting some issues with the method as well as suggestions for their improvement.

# Final words

In the current chapter, summaries of the three studies were included and contributions discussed. Each study provides both theoretical and methodological contributions, although the greater value of the studies, and thesis as a whole, rests in the latter. Specifically, Study 1 offers a novel way of measuring persistence with behavioural change, Study 2 highlights an important issue with a popular method for measuring mindfulness, and Study 3 provides the first literature review of a mindfulness measure that has become commonly used in recent years. All the studies also include ideas of how measures could be developed in further research, and in case of Study 1, applied to help to address important issues people face during behavioural change. Such issues, for instance the lack of persistence, often hinder attempts to permanently switch to a novel behaviour, despite the initial motivation to do so. On the whole, the thesis is hoping to provide new directions for rigorous future work.

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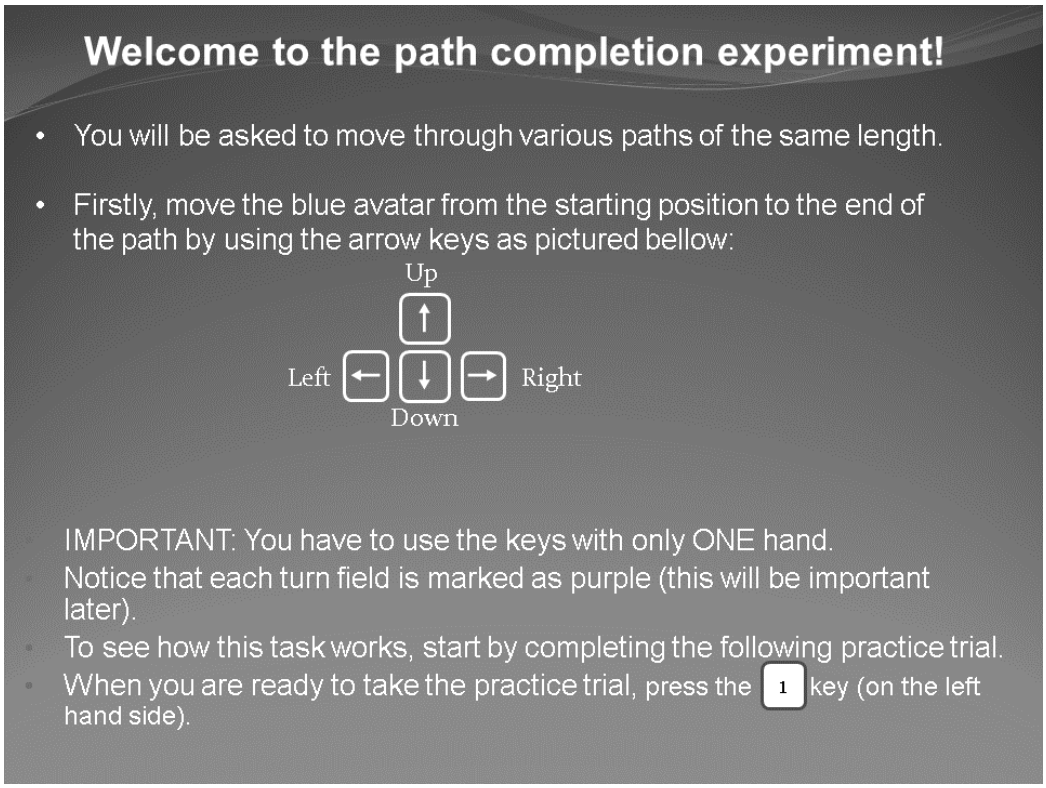
# Appendices

## *Chapter 3: Appendix A*

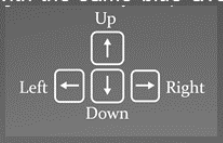
The first set of instructions



The second set of instructions

**PART 2**

- Now you will be asked to complete four paths with the same blue avatar. This time you can earn money.
- Use the same keys to move through the paths:




- IMPORTANT: You have to use the keys with only ONE hand.
- You will receive one blue coin for pressing the correct arrow key on each purple field marking the turn. If you press the wrong key, you will not receive the blue coin.
- Each blue coin is equivalent to 0.05 pence and as each path has 20 turns, you can earn up to 1 pence per path.
- Apart from making correct turns, you also need to complete each path within the 27 second limit. This limit is the length of time it took most people to complete the path in a previous study. Once the time limit is up, the path will disappear and you cannot gain any more blue coins (although you can keep those you have earned before the time limit).
- If you have any questions at this point, please raise your hand.
- Otherwise, press the 1 key (on the left hand side) to start completing the paths.

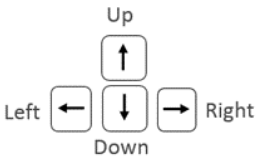
The third set of instructions

**PART 3**

- Now you will work on a number of paths for the remainder of the session.
- Before progressing from each path to the next, you will be asked to make a choice between playing for blue coins OR playing for red coins.

1. PLAYING FOR BLUE COINS

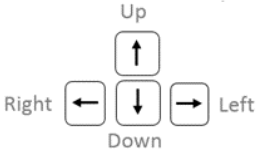
- If you choose to play for blue coins, you will move the blue avatar as you have been doing up until now using the following keys (use ONE hand):




- As before, you will earn one blue coin for pressing the correct arrow key on each purple field marking the turn. If you press the wrong key, you will not receive the blue coin. One blue coin is worth 0.05 pence, hence you can earn up to 1 pence per path.

2. PLAYING FOR RED COINS

- If you choose to play for red coins, you will move the red avatar using the following key combination (this is a **DIFFERENT** key combination to the one you have used up until now; use ONE hand):




- Please press the key 1 to continue reading the instructions.

2. PLAYING FOR RED COINS cont.

- Again you need to press the correct key on each turn but you will receive one red coin if you complete the path without making a mistake on ALL the turns and within the time limit of 27 seconds.
- One red coin has a value of 25p. Unlike the blue coin, the red coin will be awarded only at the end of each path.
- If you make any mistake on any of the turns or do not complete the path in the set time limit, you will not earn the red coin in the current trial but can earn it in future trials.
- On the whole, people tend to earn more in total if they persist in learning to use the red avatar; but this may not be true for everyone. Of course, you should choose whatever you feel is likely to work best for you.

**CHANGING FROM THE RED TO BLUE AVATAR WHILST COMPLETING THE PATH**

- Apart from choosing whether you wish to complete the path with the red or blue avatar before the start of each path, you can also switch from the red avatar to the blue avatar whilst completing the path (but not the other way round).
- To switch whilst completing the path, press the Ctrl key positioned next to the arrow keys:
- After you press this button, the red avatar will change to the blue avatar.
  This means you can play for blue coins from this moment until the time limit is up.


- Before you start completing the paths, make sure you understand these two pages of instructions (if you wish to see the previous page, press the 2 key).
- You will now be asked several questions testing your understanding of these instructions. If you answer any of the questions incorrectly, you will be returned back to the instruction screen and cannot proceed further until you answer the questions correctly
- If you have any questions at this point, please raise your hand.
- When you are ready to answer the questions testing your understanding, press the 1 key.

# *Chapter 3: Appendix B*

## Control question one

**1. What is the difference between playing for blue coins with the blue avatar and playing for red coins with the red avatar?**

a) With the blue avatar I earn one blue coin for each correct turn and with the red avatar I earn one red coin for each correct turn.

b) With the blue avatar I earn one blue coin for each correct turn and with the red avatar I earn one red coin for each correctly completed path.

c) With the blue avatar I earn one blue coin for each correctly completed path and with the red avatar I earn one red coin for each correct turn.

d) With the blue avatar I earn one blue coin for each correctly completed path and with the red avatar I earn one red coin for each correctly completed path.

## Control question two

**2. How much are blue and red coins worth?**

a) One blue coin is worth 0.5 pence and one red coin is worth 25 pence

b) One blue coin is worth 10 pence and one red coin is worth 25 pence

c) Both coins have the same value

## Control question three

**3. How can you switch between the avatars whilst completing the path?**

a) I can switch from the blue to red and red to blue avatar by pressing the Ctrl button

b) I can switch from the blue to red avatar only by pressing the Ctrl button

c) I can switch from the red to blue avatar only by pressing the Ctrl button

d) I cannot switch between the avatars whilst completing the path.

**Correct answers:** 1. b), 2. a), 3. c)

# *Chapter 4: Appendix A*

## Cognitive and Affective Mindfulness Scale - revised (CAMS-R scale)

People have a variety of ways of relating to their thoughts and feelings. For each of the items below, rate how much each of these ways applies to you.

1. It is easy for me to concentrate on what I am doing.
2. I am preoccupied by the future.
3. I can tolerate emotional pain.
4. I can accept things I cannot change.
5. I can usually describe how I feel at the moment in considerable detail.
6. I am easily distracted.
7. I am preoccupied by the past.
8. It's easy for me to keep track of my thoughts and feelings.
9. I try to notice my thoughts without judging them.
10. I am able to accept the thoughts and feelings I have.
11. I am able to focus on the present moment.
12. I am able to pay close attention to one thing for a long period of time.

2, 6, and 7 are reverse-scored; then sum values (higher values = greater mindfulness)

4 point scale: 1(Rarely/Not at all), 2 (Sometimes), 3 (Often), 4 (Almost always)

# *Chapter 4: Appendix B*

## Mindfulness induction transcripts

### *Mindfulness condition*

This is a guided body scan meditation. So lying on a mat or thick rug or on a bed. Allowing the eyes to close if that feels comfortable. Letting the hands lie alongside the body and the feet uncrossed falling away from each other and noticing the sense of the body as a whole lying here, the contact between the body and whatever is supporting you. And as you lie here, reminding yourself that we're not trying to get anywhere or striving to achieve any special state. The intention here is to spend time with each region of the body in turn, cultivating awareness of what's already here. So we're not looking for anything special to happen but allowing things to be just as we find them. So letting go of the tendency to want things to be a certain way or to judge how you're doing. Simply following along with the instructions as best you can and whenever the mind wanders away as it will tend to do, bring it back without giving yourself a hard time. So now at a certain point bring your attention to the sensations of the breath down in the abdomen, noticing the stretching of the abdomen wall on the in-breath and the falling away on the out-breath. Seeing if that's true for you. And now gathering the attention and moving it down body to the feet. Noticing what sensations there are in both feet when the attention arrives here, sensations in the toes, the soles of the feet, the heels, the top of the feet. What's here right now? If there are no sensations, then simply registering a blank. Or if they're very subtle, then simply noticing this. This is your experience right now. There's no right way to feel, simply allowing the attention to remain here. Now taking a deeper breath and on the out-breath, letting go of the feet, letting them dissolve in awareness and shifting the attention to the ankles. What sensations are here? Taking a deeper breath and on the out-breath, letting go of the ankles and shifting the attention to the lower legs, dwelling here for a few moments, noticing any sense of contact with whatever you're lying on, being fully alive to any and all sensations there may be from the surface of the skin as well as from inside the legs. Taking a deeper breath and on the out-breath, releasing the attention from the lower legs and shifting to the knees. Getting the attention rest here, not thinking about the knees but sensing directly what's here right now, noticing what sensations change and what stay the same. Seeing what's true for you right now. And at a certain point, taking a

deeper breath and on the out-breath, letting go of the knees and shifting the attention to the thighs. What do you notice here? Maybe sensations of contact with clothes on the surface of the skin, sensations of heaviness or lightness, pulsing, vibration. Any and all sensations. And now when you're ready, on an in-breath, imagining the breath could come into the body, flowing all the way into the legs, right down to the feet and back again on the out-breath up and out of the body. So that you're imagining or sensing what it would feel like if the breath could fill the legs as you breathe in and empty from the legs as you breathe out. Just playing with this sensation for the next few breaths if you choose. Taking a deeper breath and as you breathe out, letting go of the legs, allowing them to dissolve in awareness and shifting the attention to the hips and pelvis, the right hip, the left hip and the whole basin of the pelvis and the organs in this region. Perhaps imagining the breath could flow into this region on the in breath and out again on the out-breath. Then taking a deeper breath and on the out-breath, letting go of the hips and pelvis and shifting the spotlight of attention to the back, starting with a lower back. And on an in-breath, expanding the field of awareness to take in the middle of the back and then again to take in the upper back, including the shoulder blades until you're holding the whole of the back in awareness, breathing with the back. Now taking a deeper breath into the back and as you let go of the breath letting go of the back as well and moving your attention to the front of the body, to the lower abdomen, seeing what sensations there are waiting for you here as your attention moves into this region. Feeling the sensations as you breathe in and breathe out. From time to time, you may find yourself getting distracted, thought, daydreams, worries or the feeling of wanting to hurry up, to move on, feelings of boredom or restlessness may come, sometimes pulling quite strongly for your attention.

And when this happens, it's not a mistake, nothing's gone wrong. Simply taking the opportunity to notice these feelings and distractions, acknowledging them, perhaps noticing how they're affecting the body. Then without judging yourself in any way, bringing the attention back to where you had intended it to be, now in the lower abdomen, breathing. And at a certain point, taking a deeper breath and on the out-breath, letting go of the abdomen and shifting attention to the chest. What sensations are here as you cradle this part of the body in awareness, moment by moment by moment? And at a certain point, taking a deeper, more intentional breath into the chest and when you're ready, as you let go of the breath, letting go of the chest as well and shifting the attention to the hands and arms. Holding both hands and arms centre-stage in awareness

now. Now taking a deeper breath and on the out-breath, letting go of the hands and arms and shifting attention to the shoulders and neck. What sensations are here? Attending being here for them whatever they are, breathing with them. Then taking a deeper breath and on the out-breath, letting go of the shoulders and neck and moving the attention to the head and face, starting with the lower jaw and the chin, the mouth and lips, the nostrils, the surface of the nose, the cheeks and the sides of the face, and the ears, the eyes, the eyelids, the eyebrows and the space between the eyebrows, the forehead, the sides of the forehead, the temples and the scalp. And now imagining the breath could fill the whole head and that you could feel the breath on the back of the face as it comes in refreshing and renewing with each in-breath. Now imagining that the breath could fill the whole body as you lie here, breathing into the whole body and out from the whole body. And now letting go of any intentions for the breath and simply lying here allowing the body to be, just as it is. A sense of coming home to the body, allowing yourself to be just as you are - complete and whole, resting in awareness moment by moment

### *Mind-wandering condition*

In this listening exercise, you will be presented with a set of questions about your views on various topics. Your task is to think of an answer every time you are asked the question. Please give this exercise your undivided attention.

1. Restaurant

   Think of the time you last visited a restaurant.

   Where was the restaurant?
   What kind of restaurant was it?
   What food did you order?
   What was the food like?

   When are you next planning to visit a restaurant?
   What kind of restaurant would you like to visit next time?
   Do you know where this restaurant is and how you are going to get there?
   Who do you think you will go with you?

2. Shopping

   Think of the last time you went clothes shopping.

   In which town did you do your shopping?
   What shops did you go to?
   What did you buy?
   Were you happy with your purchase?

   When do you think you are going shop for clothes again?
   Where would you like to go to shop for clothes next time?
   What kind of clothes would you like to buy?
   Would you want to go alone or with someone?

3. Doctor

   Think of the last time you went to a doctor.

   When did you go to see the doctor?
   Where did you go to see the doctor?
   Why did you go to see the doctor?
   What was the outcome from seeing the doctor?

   Do you have a plan of going to see any doctor in the next few months?
   Which kind of doctor do you expect to see in the next few months?
   In your next doctor's visit, what will be the likely reason for your visit?
   What will you expect from the visit?

4. Visitors

   Think of the last time you had visitors.

   Who came to see you?
   How long was the visit?
   How did the visit go?
   Was there anything you would like to have been different about the visit?

When do you plan to have visitors next time?

Who would you like to invite to visit you next time?

What would you like to do with your visitors?

Do you have any expectations of your visitors?

5. Film

   Think of the last film you watched.

   What film was it?

   Where did you watch it?

   How long was the film and who played in it?

   How did you enjoy the film?

   What film would you like to watch next?

   Who plays in this film and where is it based?

   Why do you want to watch this particular film?

   Where would you like to watch this film?

6. Phone call

   Think of your most recent phone call.

   Who called you or who did you call?

   What were you discussing during the call?

   How long was the call?

   How did the call make you feel?

   Who are you planning to call next?

   When do you think you will make this call?

   What is the reason behind this call?

   What do you expect from the person you are going to call?

7. Gadget

   Think of the last gadget you bought.

What kind of gadget was it?

How much money did you spend for it?

Where did you buy this gadget?

Were you satisfied with the gadget?

What is the next gadget you would like to buy?

What is the maximum amount of money you are willing to spend for it?

Where will you buy the gadget?

Why do you want to buy this gadget?

# *Chapter 5: Appendix A*

Detailed results for each study

| | Induction | | | | | | |
|---|---|---|---|---|---|---|---|
| **Author (date)** | **Type** | **Length** | **Content** | **Manipulation checks** | **Design source** | **Meditation experience** | **Theoretical interpretation** |
| Adams (2013) | BM, SSM | 10 & 10 | A+A | TMS | MP | NS | Mindfulness |
| Alberts (2011) | BM | 12 | A+A | TMS | MP | NS | Mindfulness |
| Arch (2006) | BM | 15 | A+A | 1 item: the extent of following the induction instructions | MP | MN: 100% | Focused breathing |
| Bonamo (2015) | BSM | 20 & 45 | U | TMS | MP | NS | Mindfulness |
| Broderick (2005) | BM | 8 | A+A | None | MP | MN: 100% | Mindfulness |
| Carlin (2014) | BM | 15 | A+A | None | A&C | MN: 60% | Mindfulness |
| Chong (2014) | BM, BSM | 6 | A | MAAS-state | Other | NS | Mindfulness |
| Cleirigh (2015) | BM, MTE | 10 | A+A | TMS | E&R | NS | Mindfulness |
| Cropley (2007) | BSM | 10 | A+NJ | None | MP | NS | Relaxation |
| Diaz (2011) | BSM | 15 | U | None | MP | NS | Mindfulness |
| Dickenson (2012) | BM | 10 | A+A | 5 items: subjective experience | A&C | MN: 100% | Focused attention |
| Ditto (2006) | BSM | 15 | U | None | MP | MN: 100% | Mindfulness |
| Eddy (2015) | BM | 15 | A+A | TMS | A&C | NS | Mindfulness |
| Erisman (2010) | BM, MTE | 10 | A+A | TMS | MP | NS | Mindfulness |
| Farb (2007) | ES | 25 | A | None | Other | NS | Mindfulness |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Gilbert (2014) | MPR | 5 | A+A | None | Other | NS | Mindfulness |
| Grant (2013) | BM | NS | U | Raising hand to a bell sound (attentiveness assessment) | MP | MN | Mindfulness |
| Hafenbrack (2014) | BM | 15 | A+A | 3 items: focus and physical sensations of breathing, being in touch with body | A&C | NS | Mindfulness |
| Heppner (2008) | RE | 5 | A | None | MP | NS | Mindfulness |
| Hesser (2013) | BM | 6 | A+A | None | MP | NS | Mindfulness |
| Hilt (2012) | BM | 8 | A+A | None | Other | NS | Mindfulness |
| Hong (2011) | RE | 10 | A | None | MP | NS | Mindful eating |
| Hong (2014) | RE | NS | A | None | MP | NS | Mindfulness |
| Hooper (2010) | BM | 10 | A+A | None | A&C | NS | Mindfulness |
| Hooper (2011) | BM | 9 | A+A | 1 item: implementing instructions on the tape | A&C | NS | Mindfulness |
| Huffzinger (2009) | MPR | 8 | A+A | NS | Other | NS | Mindful self-focus |
| Johnson(2013) | BM | 25 | A+A | TMS, 1 item: feeling of trully meditating during induction | Original | MN: 100% | Mindfulness |
| Jordan (2014) | BSM | 15 | U | None | MP | NS | Mindfulness |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Kee (2012) | BSM | 6 | A | Usefulness and Concentration subscale | Original | NS | Mindfulness |
| Kee (2013) | BSM | 6 | A | MAAS-state | Original | NS | Mindfulness |
| Kiken (2011) | BM | 15 | A+A | MAAS-state | A&C | NS | Mindfulness |
| Kiken (2014) | BM | 10 | A+A | None | A&C | MN: 75% | Mindfulness |
| Kramer (2013) | BM | 10 | A+A | None | MP | NS | Mindfulness |
| Kuo (2015) | BM | 5 | A | None | Other | NS | Mindfulness |
| Lai (2015) | BM | 15 | A+NJ | TMS | MP | MN: 100% | Mindfulness |
| Lakey (2011) | BM, MTE, BSM | 6 | A+A | None | Other | MN: 100% | Mindfulness |
| Lalot (2014) | SSM | NA | A | 1 item: following the instructions | Original | MN: 100% | Mindfulness |
| Larson (2013) | BM | 14 | A+A | Systolic blood pressure | MP | MN: 100% | Mindfulness |
| Laurent (2015) | BM, MTE | 10 | A+A | None | E&R | NS | Mindfulness |
| Lee (2014) | BM | 20 | A | MAAS-state | Other | MN: 100% | Mindfulness |
| Long (2015) | BM | 12 | A+A | 2 items: present moment focus | Other | NS | Mindfulness |
| Marchiori (2014) | BSM | 14 | A+A | None | Other | NS | Mindfulness |
| McHugh(2010) | BM | 10 | A+A | None | A&C | NS | Mindfulness |
| McHugh(2012) | BM | 15 | A | None | A&C | NS | Mindfulness |
| McHugh(2013) | BM | 10 | A+A | None | A&C | NS | Mindfulness |
| Michal (2013) | BM, SSM | NA | A | 1 item: feeling grounded in | Original | No formal training | Mindfulness |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | one's body | | | |
| Miller (2014) | BM | 13 | A | 5 items: about the induction | Other | NS | Focused attention |
| Murphy (2014) | SSM | NA | A+A | Items: distraction and observing & accepting | Other | NS | Mindfulness |
| Ostafin (2012) | BSM | 10 | A+A | 1 item: taken from the MAAS scale | Other | NS | Mindfulness |
| Papies (2012) | MTE | NA | A | None | Original | MN: 100% | Mindful attention |
| Pepping (2013) | BM, MTE | 15 | U | MAAS-state | Original | NS | Mindfulness |
| Pepping (2015) | BM, MTE, BSM | 15 | U | MAAS-state | MP | MN: 100% | Mindfulness |
| Petter (2014) | BSM | 10 | A+A | MAAS-state | MP | Range of experience | Mindful attention |
| Prins (2014) | SSM | 10 | A+A | None | Original | Most not regular | Mindfulness |
| Ramos Diaz (2014) | OD | 10 | A+A | None | Original | NS | Mindfulness |
| Ramsey (2015) | RE | 5 | A | Observing whether participants engaged in the task and asking about the exercise | Other | NS | Mindfulness |
| Reb (2014) | RE, SSM | 6 & 3 | A | 8 items: from trait scales | MP | NS | Mindful attention |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Reed (2015) | BM | 10 | A+A | None | A&C | NS | Mindfulness |
| Remmers (2014) | ES | 8 | A+A | None | Other | NS | Mindfulness |
| Reynolds (2015) | BM, MTE | 10 | A+A | TMS | E&R | NS | Mindfulness |
| Rosenstreich (2015) | BM, BSM | 30 | U | None | MP | MN: 100% | Mindfulness |
| Saunders (2013) | RE | 15 | A | TMS | Other | NS | Mindfulness |
| Sharpe (2013) | BSM | 12 | A+NJ | TMS | MP | NS | Mindfulness |
| Tan (2014) | BM | 5 | U | MAAS-state | Other | MN: 100% | Mindfulness |
| Ussher (2014) | BSM | 10 | A+A | 6 items: decentering, present focus and pain acceptance | Other | MN: 67% | Mindfulness |
| Vernig (2009) | MPR | 8 | Acceptance | 3 items: material understanding and strategy usefulness | Other | NS | Mindfulness |
| Vinci (2014) | BM | 10 | A+A | TMS | Other | NS | Mindfulness |
| Vlemincx (2013) | BM | 11 | A+A | None | A&C | NS | Mindfulness |
| Weger (2012) | RE | 5 | A | TMS | Other | MN: 100% | Mindfulness |
| Wilson (2015) | BM | 15 | A+A | None | A&C | NS | Mindfulness |
| Winning (2015) | BM | 15 | A+A | 5 items: present moment focus | Other | NS | Mindfulness |
| Yusainy (2015) | BM, BSM | 15 | A+A | TMS | MP | MN | Mindfulness |
| Zabelina (2011) | BM | 10 | A | Describing oneself | Other | NS | Mindfulness |

Note. Induction type legend: BM = Breathing Meditation, BSM = Body-Scan Meditation, MTE = Mindfulness of Thoughts or Emotions, RE = Raisin Eating exercise, SSM = Subject-Specific

Meditation, MPR = Mindful Prompt Reading, ES = Experiential Self-focus, OD = Observing and Describing; Induction length is in minutes; Induction content legend: A = Attention only, A+A = Attention and Attitude, A+NJ = Attention and Non-judgment, U = Uncertain; Manipulation checks legend: TMS = Toronto Mindfulness Scale, MAAS-state = Mindfulness Attention Awareness Scale (state version); Design source legend: A&C = Arch and Craske's (2006) adaptation, E&R = Erisman and Roemer's (2010) adaptation, MP = Mindfulness Programme, Other = Other experimental study adaptation, Original = Original design; Meditation experience: MN = Mostly Novices (60-100%), NS = Not Specified.

# *Chapter 5: Appendix B*

## The studies used for the methodological analysis


Alberts, H. J. E. M., & Thewissen, R. (2011). The Effect of a Brief Mindfulness Intervention on Memory for Positively and Negatively Valenced Stimuli. *Mindfulness*, *2*(2), 73–77. http://doi.org/10.1007/s12671-011-0044-7

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Baer, R. a, Smith, G. T., & Allen, K. B. (2004). Assessment of mindfulness by self-report: the Kentucky inventory of mindfulness skills. *Assessment*, *11*(3), 191–206. http://doi.org/10.1177/1073191104268029

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Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., … Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice*, *11*, 230–241. http://doi.org/10.1093/clipsy/bph077

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